35 boiler operating economy
39 stop refrigeration losses
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47 chimney action
49 power plant betterment
52 quick electric connectors
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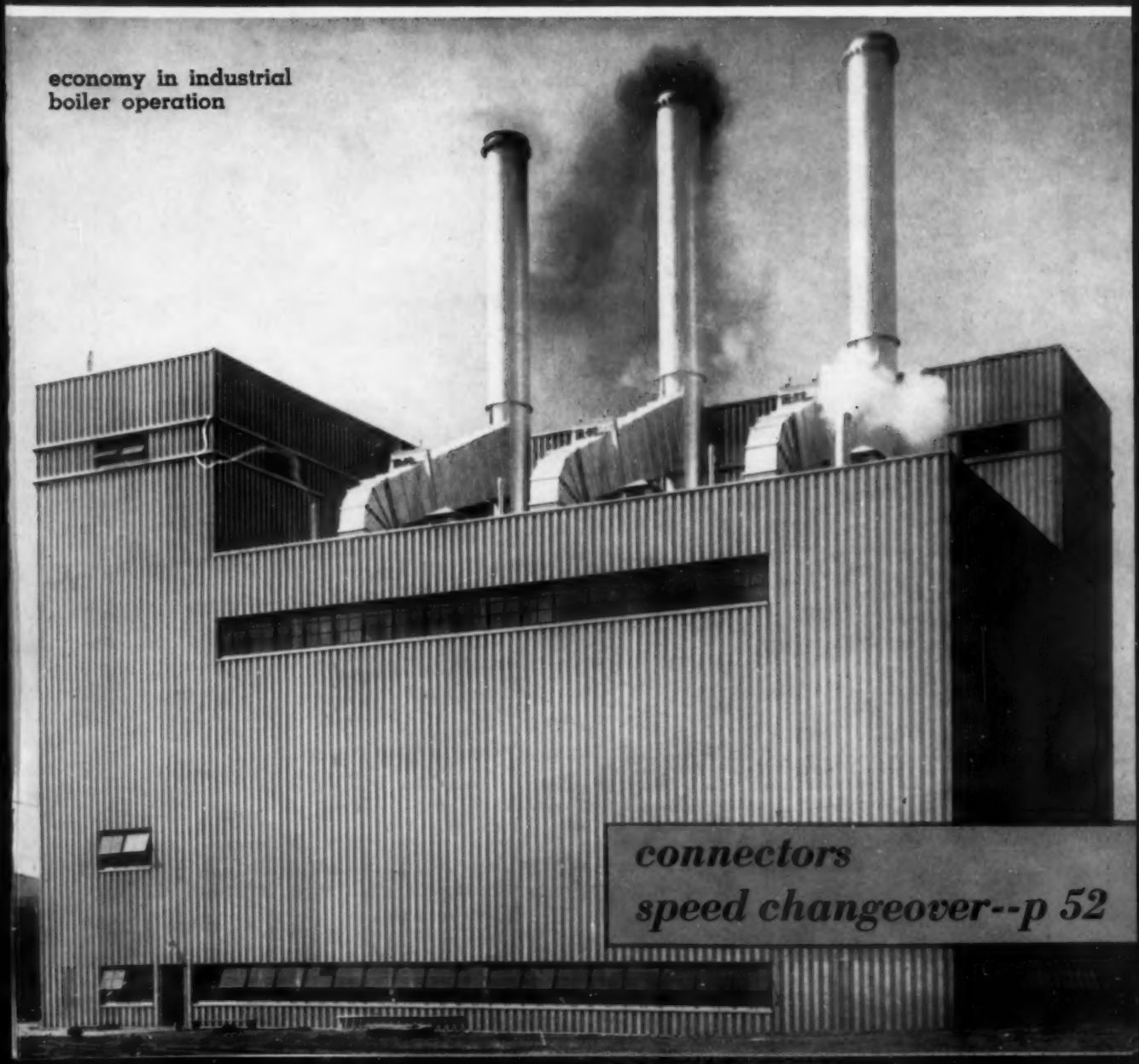
APRIL 1950

A PUTMAN PUBLICATION

Industry & Power

For men who manage industry's power services

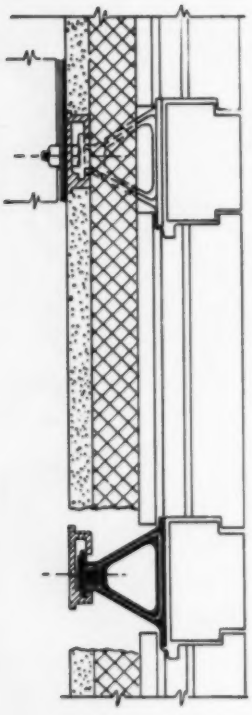


economy in industrial boiler operation

connectors speed changeover--p 52

INTRODUCING
BIGELOW-LIPTAK'S
BI-MET*

Insulated Furnace Walls
For High Temperature Applications

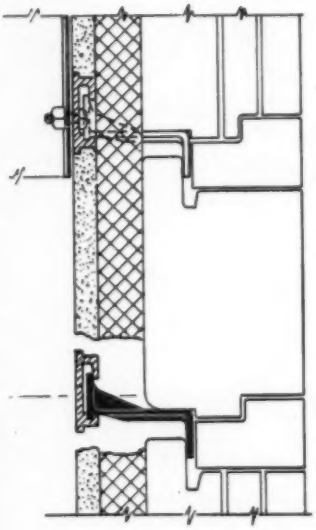


The 4½ inch wall

Here's a job-proven idea which is designed to pare the costs of suspended furnace enclosures. It's used when temperatures are going to be high and when expensive special alloy supporting castings must be used.

Two different castings are used. The first, an alloy clip casting is embedded in the tile where temperatures are highest. This, in turn, is fastened to a standard cast iron support. The design permits the most economical use of costly alloys.

This is a Bigelow-Liptak BI-MET wall and it is another example of B-L's efforts to produce quality furnace enclosures at lower and lower initial costs. Remember: a suspended enclosure for a boiler, a refinery heater, or any other type of installation, will *last longer, have less down time for repairs.* That makes a suspended job the cheapest in the long run. Want to cash in on savings like these? Contact the B-L office nearest you.



The 7 inch wall

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AND BIGELOW-LIPTAK EXPORT CORPORATION
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UNIT-SUSPENDED WALLS AND ARCHES

In Canada: BIGELOW-LIPTAK OF CANADA, LTD., *Toronto, Ontario*

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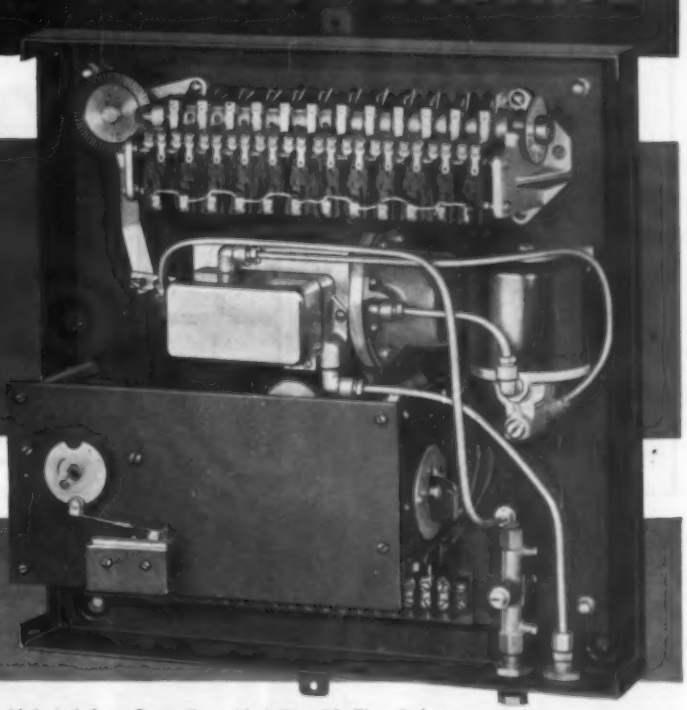
Circle 145 on READ-N-CIRCLE card for more data

REFRIGERATION CAPACITY CONTROL

JOHNSON Pneumatic Step Controller



- BALANCES CAPACITY WITH LOAD
- PREVENTS SHORT CYCLING
- EQUALIZES WEAR OF EQUIPMENT

12 Switch Step Controller with Adjustable Time Delay, Recycler Solenoid and Automatic Sequence Changer.

What It Does

This new and improved controller is designed to accomplish, with a single compact unit, everything that is desired for the control of multiple step refrigeration installations, including "on" and "off" operation of the steps in sequence, positive prevention of the starting of more than one compressor at a time after night shutdown or after current failure, and manual or automatic changing of compressor operating sequence to equalize wear. It can be used to control one or a group of refrigeration machines. It completely eliminates all the disadvantages of a series of separate pressure switches.

How It Works

The Johnson Pneumatic Step Controller, in response to changes in pressure from a controlling thermostat, actuates a number of separately adjustable, snap-acting, single-pole, double-throw switches in any desired sequence. Control arrangements include (1) starting and stopping two or more compressors in sequence, (2) operation of cylinder unloaders in sequence, or (3) a combination of (1) and (2).

Special Features

Recycler and Time Delay—Recycler Solenoid immediately returns all switches to their normal position on shutdown or current failure. Time Delay assures the proper interval between successive switch operations on start-up or when current is restored after failure.

Sequence Changer—Varies the starting sequence of compressors to equalize running time and wear. Step Controllers are furnished with either Manual or Automatic Sequence Changer.

Models—Choice of 4, 6, 8 and 12 switch units, with or without special features such as Recycler, Adjustable Time Delay and Sequence Changer.

* * *

Installation and operation of the Johnson Pneumatic Step Controller is both simple and inexpensive. A nearby Johnson engineer will gladly explain, without obligation, how it can best solve your special problems, or write today for full details.

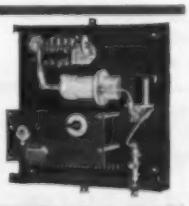
JOHNSON CONTROL

SINCE 1885

PLANNING • MANUFACTURING • INSTALLING

OTHER APPLICATIONS

Johnson Step Controllers are also used to control multiple fan or pump installations, electric heaters and other systems where electrically actuated devices are to be operated in sequence from a proportional acting pneumatic controller. Send the coupon for more facts.



JOHNSON SERVICE COMPANY
507-LL East Michigan St., Milwaukee 1, Wis.

Please send me Apparatus Bulletin G-180 describing specifications, features and application of Johnson Pneumatic Step Controllers.

NAME_____

FIRM_____

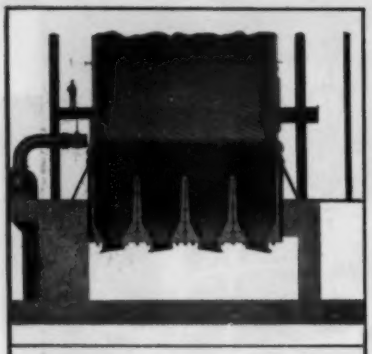
ADDRESS_____

CITY & STATE_____

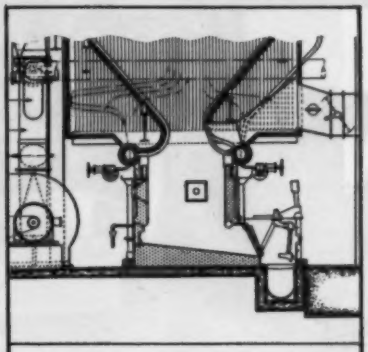
Circle 146 on READ-N-CIRCLE card for more data

ASHPIT REFRACTORY CASTABLES

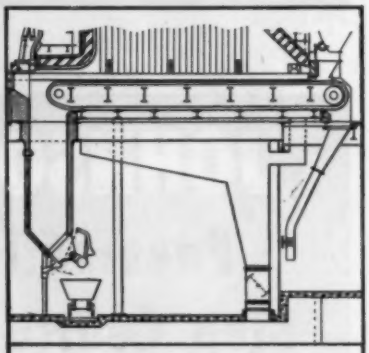
Rugged B&W Kaocretes Stand Up Under Abrasion and Erosion



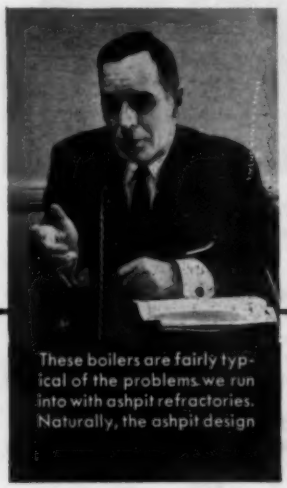
Erosion, due to dry ash sliding down the hopper, is the big problem in this ashpit.



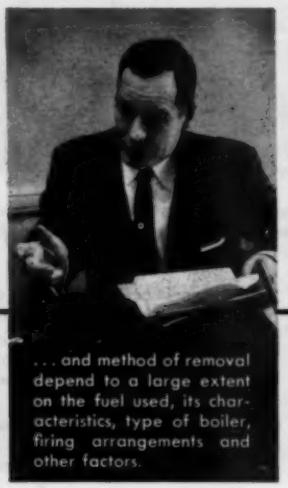
Water jets can cause abrasion of ashpit floor refractories, and water splattered on the walls may cause spalling.



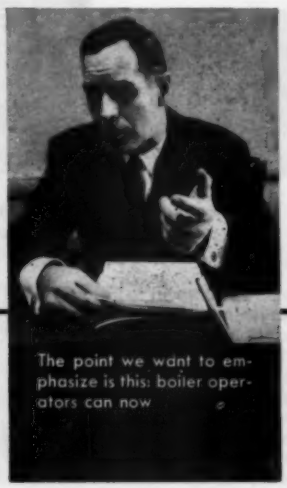
Continuous deposits of ash from a stoker-fired boiler have an abrasive effect on this ashpit lining.



These boilers are fairly typical of the problems we run into with ashpit refractories. Naturally, the ashpit design



... and method of removal depend to a large extent on the fuel used, its characteristics, type of boiler, firing arrangements and other factors.



The point we want to emphasize is this: boiler operators can now

... cut their refractories maintenance, in practically all ashpits, with the use of special refractory castables such as B&W Kaocrete A and D.

How B&W Refractory Castables Cut Ashpit Maintenance

When you consider the punishment ashpit refractories have to take, it's no wonder they are usually the most expensive item of refractories maintenance.

In almost all ashpits, they have to stand up under abrasion and erosion of the ash itself. If the ash is quenched in a water-filled hopper or with sprays, the hot ashpit walls may be splattered with water. The refractories must have spalling resistance to withstand this thermal shock. If the ash is removed by "raking out" or by high velocity water jets, the lining must be able to take this kind of abuse.

How do refractory castables stand up in this kind of service? Here's an example: A public utility made a trial installation of B&W Kaocrete in one of their ashpits. It gave over two years more maintenance-free service than the refractory previously used.

On the strength of this performance, another ashpit was lined with B&W Kaocrete—and this was a tough one. Two opposing high velocity sprays were used for quenching and ash removal. Water splattered on the ashpit walls, which meant the lining was subjected to severe thermal shock. In addition, the jets had an abrasive effect on the floor.

The service was superior to the refractories used before. As a result, this public utility is using B&W Kaocrete to line all ashpits.

These are examples of installation savings made possible by using refractory castables instead of brick. B&W Kaocrete D was specially developed to have unusually high resistance to abrasion, erosion and spalling—properties that are essential in ashpit service. For less severe operating conditions, B&W offers Kaocrete A, which will also give satisfactory service in many types of installations. Your local B&W Refractories Engineer will be glad to give you complete details on the performance of these B&W Refractory Castables.

THE BABCOCK & WILCOX CO.
Refractories Division
General Offices:
161 East 42nd St., New York 17, N. Y.
Works: Augusta, Ga.

a-530

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Industry & Power

SERVING INDUSTRY'S POWER SERVICES

VOLUME 70 NO. 4 APRIL 1956

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Temperature Indicating Instruments

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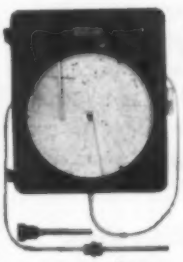

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nuclear news

. . . about industry & power

URANIUM MARKET—ANOTHER LOOK

According to an AEC spokesman, "Military requirements will continue to be the dominant factor in the demand for uranium for some time. No significant industrial requirements are expected before 1960, and probably no important requirements until after 1965. Consequently, Commission's uranium procurement program will continue to be determined largely by what the military want. . . . Although we no longer are faced with a problem in finding uranium for the current defense program, it is important to develop reserves to assure a long-range continuing supply for the coming atomic power industry and for possible future military needs."

AEC GIVES GO-AHEADS

AEC has determined that the revised proposal of the Yankee Atomic Electric Company to build a nuclear power plant is an acceptable basis for negotiation. Net electrical capability of the plant is to be 134,000 kw. . . . AEC has authorized design and development of a high-energy particle accelerator by Midwestern Universities Research Association and of a high-energy accelerator by Argonne National Laboratory. . . . Argonne National Laboratory has been assigned responsibility for design and development of a military nuclear reactor plant for production of electricity and for space heating. Primary design objectives are system simplicity, ease of transport and construction, reliability, ease of operation, and extended operation without maintenance downtime.

FRESH ESTIMATES ON NUCLEAR POWER GROWTH

AEC's W. Kenneth Davis, director of Reactor Development Division, recently offered estimates of the growth of nuclear power in this country, based upon what are considered to be realistic assumptions concerning the time required for reactor costs to decrease, and the growth of total demand for electricity. He said "Even with pessimistic assumptions, 1980 may find over 54 million kw of nuclear power capacity in the United States. It may not be unreasonable to expect this to be increased to over 100 million kw. This corresponds to almost 40 percent of the new generating capacity installed by that time, and

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about 15 percent of all generating capacity estimated to be required by 1980." Davis went on to discuss the time required to complete a new reactor based on a technology demonstrated by a previous one. His timetable shows:

Component development and testing	1 to 3 years
Engineering design	1 year
Construction	2 to 3 years
Testing and initial operation	½ to 1 year
Total	4½ to 7 years

SAN FRANCISCO TO GET NUCLEAR POWER PLANT

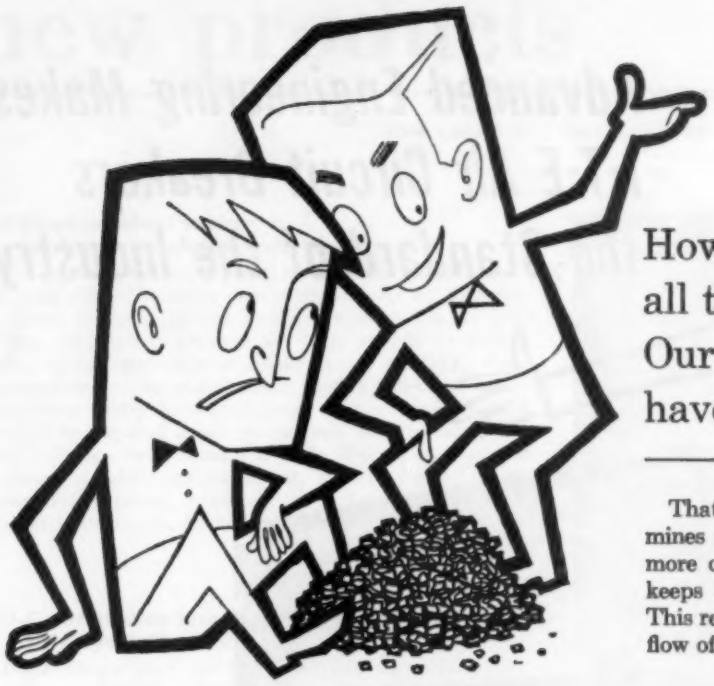
General Electric Company and Pacific Gas Electric Company will build and operate an atomic power plant to serve the San Francisco Bay area. Initial maximum generating capacity will be 5000 kw, and ultimate capacity will be 10,000 kw or more. Cost will be between $3 million and $4 million. This brings to 15 the number of civilian atomic power plants under construction, in design, or proposed for completion between 1957 and 1962. Nearly 1 million-kw generating capacity is represented by these plans.

FIRST CRITICAL FACILITY FOR PRIVATE INDUSTRY

First permit to construct a critical experiment facility for nuclear reactor core tests in private industry has been granted to Babcock & Wilcox. Critical experiment facility will test nuclear characteristics of full-scale atomic reactors without generating appreciable quantities of heat. Reactor designers will use information obtained from these experiments to confirm theories and calculations, and to establish final distribution of fissionable, fertile, and structural material within reactors.

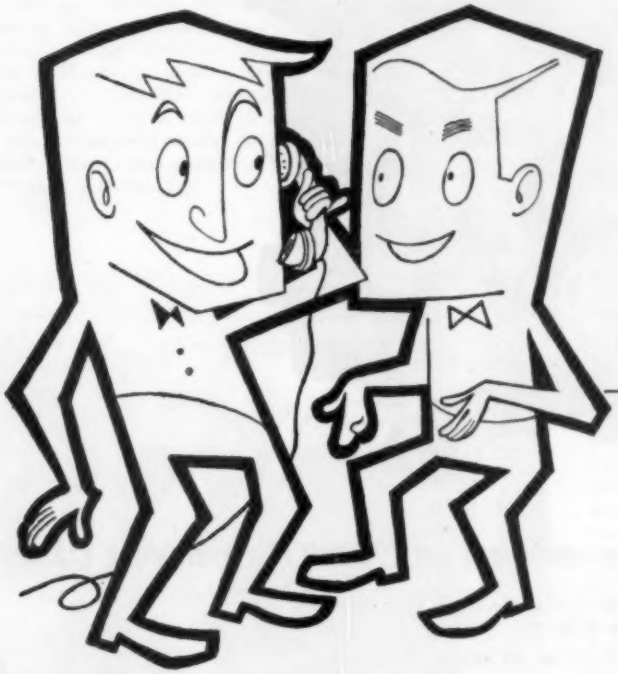
CHALK UP FOREIGN FIRSTS

First foreign nuclear contract for Vitro Engineering Division, Vitro Corporation, will be preliminary study of large heavy water and nitrogen fertilizer plant for the government of India. Large quantities of hydrogen, ammonia, nitric acid, and ammonium nitrate will be produced in combination with manufacture of heavy water, making production of heavy water cheap compared to other methods. . . . First international nuclear power plant pact has been drawn up between AMF Atomics Inc. and Mitchell Engineering Ltd., London. Joint design and construction of nuclear power plants in the British Commonwealth and other countries will be undertaken by the combine.



How come you can get all the coal you want? Our deliveries have been slow!

That's because we buy all our coal from mines on the Chesapeake & Ohio. C & O has more coal cars than any other railroad and keeps close to 99% of them in good order. This ready car supply means an uninterrupted flow of coal to consumers.



How about the coal? Is that as good as the service?

C & O territory has always been known for the superior quality coal it produces. And the C & O fuel service engineer is always ready to help us find exactly the right coal for our particular needs.

P.S.

There's a lot more to buying coal than the cost per million BTU. Why not contact coal producers on the C & O to solve your particular fuel requirements, or write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake & Ohio Railway Co., Terminal Tower, Cleveland 1, Ohio, for the assistance of a C & O fuel service engineer.

Chesapeake and Ohio Railway

WORLD'S LARGEST CARRIER OF BITUMINOUS COAL

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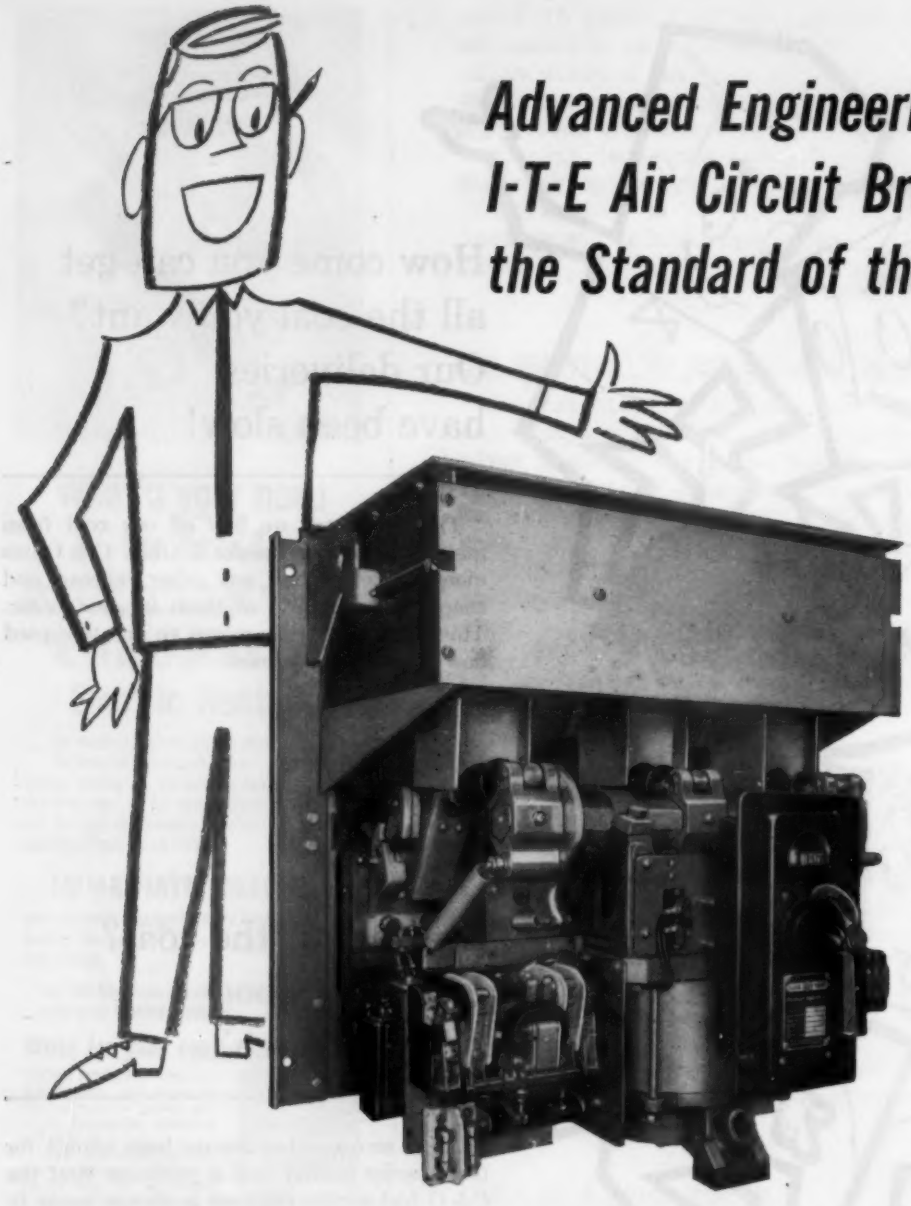

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I-T-E CIRCUIT BREAKER COMPANY • Switchgear Division

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new products

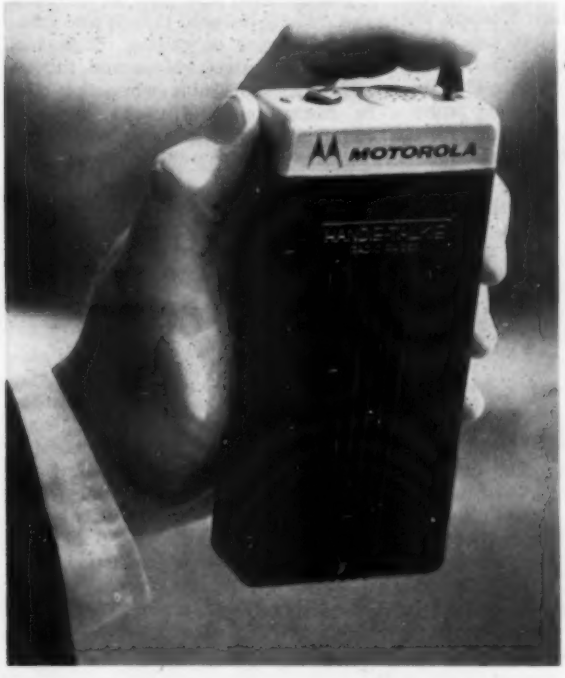
. . . just circle key numbers on READ-N-CIRCLE card on page 69

700-Heat-resistant rubber triples hot-material belt life

Hot-material conveyor belt made with special heat-resistant rubber outlasts conventional belts by as much as three to one. Special rubber remains pliable and elastic, even when exposed for long periods to baking action of hot materials at temperatures to 350 F. Conventional hot-material belts soon harden and crack under such heat conditions. Fabric plies in conventional belts become brittle and break in the belt fastener area, but new Solarflex belts remain flexible. Belt is available in a choice of fabric reinforcement, including glass fabric, rayon-nylon, rayon, cotton-nylon, and cotton. THE B. F. GOODRICH COMPANY, INDUSTRIAL PRODUCTS DIVISION.

701-Colored slide rule cuts eyestrain and errors

Light-alloy slide rules made in green-yellow eliminate violet and red rays which focus in front of and behind retina. Color coincides with optimum sight point of spectrum, cutting eyestrain, blurring, and errors in reading calibrations. Noncorrosive, nonrusting metal construction eliminates warping, swelling, and binding. Available in 6-in. and 10-in. Trig, Log-Log standard rules, or made to special order. Metal construction allows calibration to seven decimal places. Accuracy guaranteed PICKETT & ECKEL, INC.



702-Intraplant communication receiver fits in your pocket

Private, individual paging of key personnel is now possible with a new pocket radio paging system. System consists of a selector console with individual buttons for key personnel, an FM transmitter that radiates alerting tones and voice messages within a confined area, and individual all-transistorized radio receivers. Receptionist merely presses proper selector button to activate individual's receiver alerting mechanism, then speaks the message into a desk microphone. No other receiver in the Handie-Talkie system hears either the alerting tone or the voice message that follows. Selective calling method uses matched precision vibrating reed mechanisms—one in each pocket receiver to correspond with another activated by the console selector button. Receiver itself weighs only 10 ounces and measures only slightly larger than a pack of king-size cigarettes. Unit can be clipped in pocket or worn on belt. FM reception is immune to common types of interference generated by X-ray, diathermy, and other noise-generating equipment. Receiver is powered by a 4-volt mercury cell battery, and battery life is approximately four 40-hour weeks. Unit operating cost is about 3 cents per 8-hour work day. Audio volume of paged message, although adequate for the paged person to hear message, is low enough to preserve privacy. MOTOROLA COMMUNICATIONS & ELECTRONICS, INC.

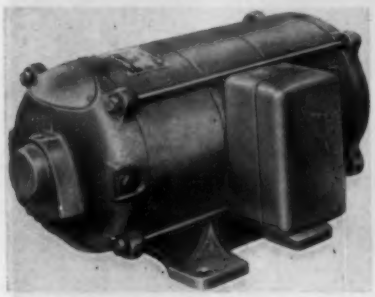
(more new products on page 12)

new products

. . . starts on page 11

703-Inexpensive dc from ac power source

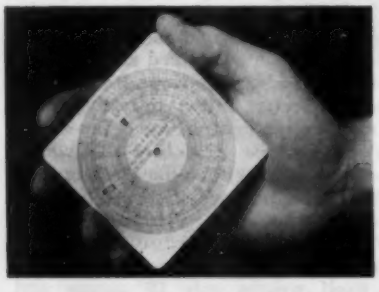
Fractional horsepower motor-generator sets, in frame sizes 44, 66, and 74 provide inexpensive and reliable



means of obtaining direct current from ac power. Continuous operation at rated load is possible through a ventilating system that incorporates a fan on the shaft between units. Both motor and generator rotors are mounted on common shaft, which eliminates problems of shaft alignment. Available with 250-, 500-, and 750-watt dc outputs and various inputs. General Electric Company.

704-Pocket calculator converts meters to inches

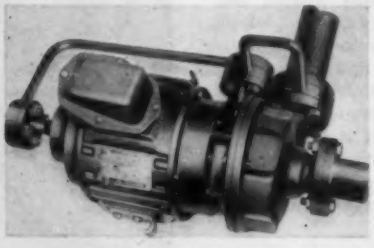
Inexpensive plastic plus-minus calculating chart performs the same functions as much more elaborate slide rule calculators. Consists of a



circle of seven sets of figures, five on the master chart, and two on an overriding disc. Chart enables user to figure from the inch system into millimeters or vice-versa. Oil-, dirt-, and acid-resistant chart measures 4⅞ by 3⅜ in. Will be particularly useful to engineers who must figure in inches, millimeters, and decimals of either system. Can be extended if desired on special orders. Industrial Marketing Services Co.

705-Leakless, general purpose centrifugal pump

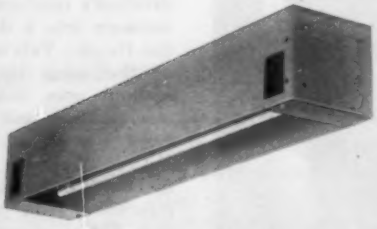
Leakless, general purpose centrifugal pumps use canned motor principle. Are now available in a fractional horsepower line for motors through



two hp, and an integral horsepower line for motors above two hp. Capable of accommodating heads to 250 feet, temperatures to 250 F. Canned construction eliminates packing or mechanical seals. Have long-life fluid piston radial bearings throughout that are supplied with liquid through an internal connection with pump casing discharge nozzle. Require minimum maintenance. Allis-Chalmers Manufacturing Company.

706-Radiant heating units fit wider applications

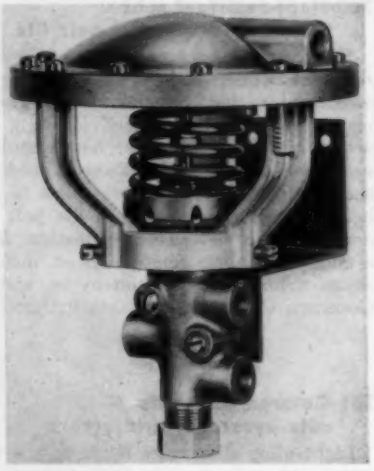
Infrared sources, vastly different from well known infrared lamps, are now available in quartz lamp and radiant rod oven sections. Both types assemble easily into complete infrared ovens. New quartz lamp equipment makes possible temperatures over 1000 F. High-temperature (4000 F) tungsten filament is sealed



in an inert gas atmosphere within a rugged, translucent, fused quartz shell. This permits high radiation efficiency. Radiant rod equipment, incorporating sheathed metal elements, makes an efficient, low-cost infrared unit. One unit replaces four conventional units. The Fostoria Pressed Steel Corporation.

707-Pneumatic switching valve simplifies piping

Pneumatically operated switching valve for use with dual pressure pneumatic control systems switches automatically on a dual supply pressure change, eliminating need for separate air line from central station. V-132 reduces installation time and



cost, and eliminates need for a second pressure-electric switch and solenoid air valve. Three pipe connections are: normally open, narmally closed, and common. Exhausting three-way valve is lightweight and compact. Johnson Service Company.

708-Teflon pipe dope stops galling

Teflon-based pipe dope for corrosive and difficult-to-hold liquids also minimizes seizure or galling. High cost of stainless steel valves and fittings is partly recoverable when they can be dismantled and used again. T-Film[R] permits use of threaded compo-

FREE INFORMATION

For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card on page 69.

nents in place of costlier flanged, gasketed, or welded assemblies. Also useful for assembling dissimilar metals—minimizes possibility of galvanic corrosion. Has successfully prevented seizure of threaded connections subjected to Arctic temperatures with accompanying thermal shrinkage. Should be extremely useful in food processing and refrigeration industries. Makes use of cheaper threaded fittings possible in place of flanged or welded fittings. Eco Engineering Co.

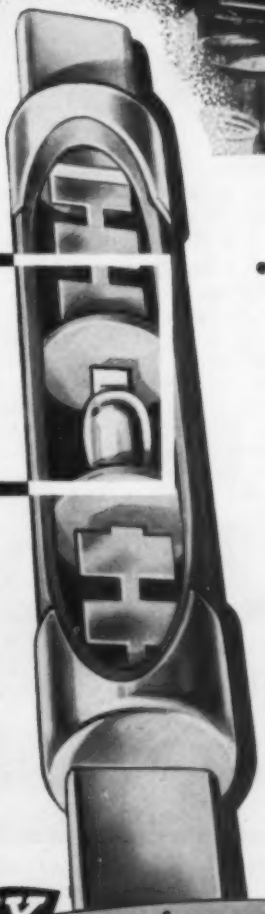
(more new products on page 14)

what good is
AUTOMATION
when
FUSES FAIL?

ECON®
dual-element cartridge fuses

exclusive with ECON

Only Econ Fuses have the Econ-Alloy thermo element which has the property of changing from a solid to a liquid, without going through a plastic state. This makes possible Econ's faster and more accurate protection against harmless overloads and short circuits.



...give you this **dual** protection
against fuse failure

1 ECONS give time-controlled protection against unnecessary blowouts from temporary and harmless overloads . . . a frequent cause of shut-downs.

2 ECONS give instantaneous protection against short circuits . . . operate at low temperature . . . prevent overheated circuits.

Available at leading electrical wholesalers in knife and ferrule types: 0 to 600 Amp., 250 to 600 V. Underwriters' Laboratories approved. Write us for new ECON Catalog S-60 or for Complete Line Fuse Folder.

See Your Electrical Wholesaler for ECON and other Fuses

ECONOMY fuses for every purpose

5107

ECONOMY FUSE & MFG. CO., 2717 Greenview Ave., Chicago 14, Ill.

Circle 113 on READ-N-CIRCLE card for more data

Kalamazoo

offers 3 bulletins to help you plan STORAGE BINS, TANKS, CHESTS for Bulk Materials in Process or Storage

1

Shows cross sections and details of Kalamazoo Industrial Storage Bin construction plus advantages of maintenance-free Kalamazoo Vitrified Glazed Tile. Application photos.

2

Eight pages describing round and rectangular Wood Tanks, Special Vats, Flumes, Ducts and Frost-Proof Wood Boxing, used in processing and bulk storage. Construction details, numerous examples.

3

Illustrates Kalamazoo Split Tile and Unit Tile for straight or curved tanks and chests. Also Tile Lining for old or new tanks, pits. Applications shown.

Fill out and mail coupon today.

CHECK BULLETINS YOU WANT—
Kalamazoo TANK AND SILO CO.
441 Harrison Street
Kalamazoo, Michigan, Phone 5-2141

- ☐ 1—Tile Storage Bins, Bul. 1153-B
- ☐ 2—Wood Tanks, Bul. 655-W
- ☐ 3—Tile Tanks, Chests, Bul. 1055-T

Name_____
Title_____
Firm_____
Street_____
City_____ Zone____ State_____

Kalamazoo | TANK & SILO CO.

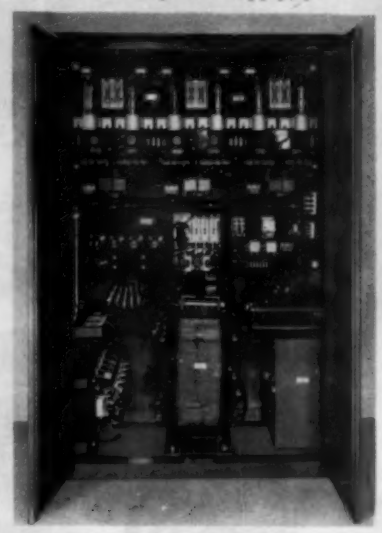
Circle 138 on READ-N-CIRCLE card

new products

. . . starts on page 11

709-Thyratron dc speed control allows constant torque

Variable speed motor drive, consisting of a dc motor with an electronic rectifier power supply, permits



constant full-load torque at all speeds from minimum to maximum. Speed ranges of 10:1. THER ELECTRIC WORKS.

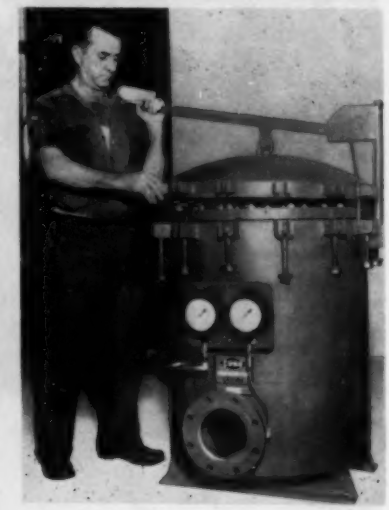
710-Flooring compound handles 20-ton loads

Improved flooring compound that will stand up under extra-heavy steel-wheel trucking is formulated with tough granular plastic resins and extra-fine nonstone aggregates. Heavy-trucks, and trucks with narrow steel wheels roll quickly and easily over surface. Easily handles

20-ton loads. Can be used to patch or resurface any concrete, indoors or outdoors. Easily applied without chipping or roughening old surface. Ready for use within four to six hours. THE MONROE COMPANY, INC.

711-Micronic, full-flow filters have quick-opening housing

Micronic, full-flow filters with quick opening housings simplify maintenance and reduce cartridge replacement costs. One man can remove cartridges in a matter of minutes. Degrees of filtration using



Micro-Klean cartridges are 5, 10, 25, and 50 microns. Largest in series has flow rate of 500 gpm clean oil at 150 SSU, 25-micron filtration, and a pressure drop of only 2 psi. Smallest unit handles 80 gpm. CUNO ENGINEERING CORPORATION.

712-Flexible aluminum tubing up to 2-in. id

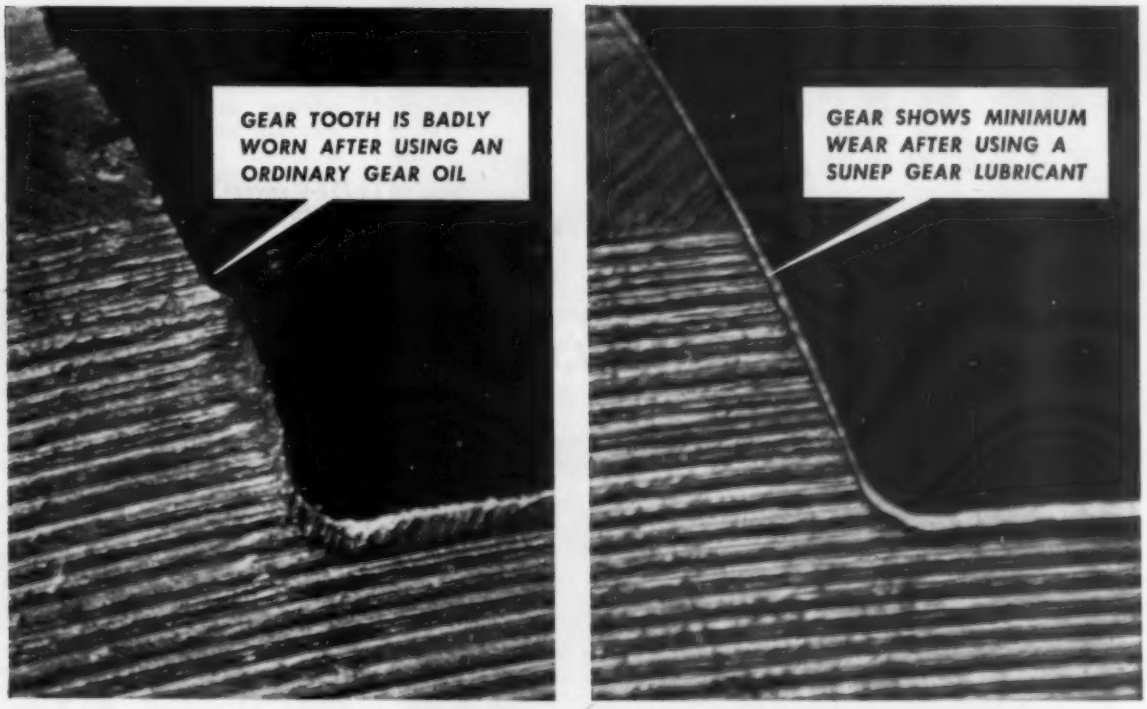
Flexible seamless aluminum tubing comes in 2-in. id size. Outside diameter is 2 15/16 in. and wall thickness .022 in. Standard length is 9 in. Depending upon internal pressure and operating conditions, tubing is furnished in open or close pitch heli-

cal convolutions, with or without metallic braid jacket. Standard pipe thread flare-type fittings are applied without solder, braze, or packing. Special end connections available. SEAMLEX COMPANY, INC.

(more new products on page 16)

FREE INFORMATION

For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card on page 69.



COMPARATIVE TESTS on identical new worm gears demonstrate superiority of Sunep Gear Lubricant. Gear on left, using a compounded cylinder oil, shows excessive wear at 70 hours. Gear on right, protected by Sunep, shows minimum wear after running over 200 hours!

HERE'S PROOF SUNEP GEAR LUBRICANTS MINIMIZE WEAR

Sunep Gear Lubricants cut power losses...protect against overloads ...lengthen gear life...reduce maintenance costs and replacements.

During recent tests gear units protected by Sunep Gear Lubricant showed an absolute minimum of wear when run at normal rated capacity. There was no indication of scoring or wear even when run at overloads up to 118%! Power consumption was reduced up to 25%. Damage from shock loads was nil.

In addition to outstanding load-carrying ability, Sunep Gear Lubricants are extremely stable, non-corrosive, prevent rusting, keep gears and bearings clean.

For complete information about how Sunep Gear Lubricants can help give longer life to your worm gear units, see your Sun representative...or write SUN OIL COMPANY, Philadelphia 3, Pa., Dept. IP-4.

SUNOCO

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY PHILADELPHIA 3, PA.

IN CANADA: SUN OIL COMPANY, LTD., TORONTO AND MONTREAL

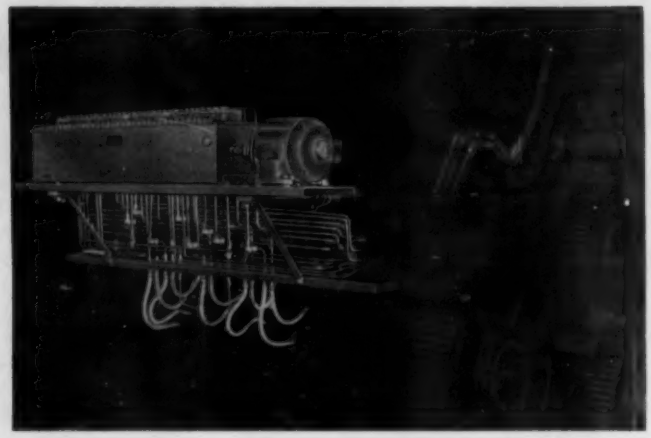
Circle 129 on READ-N-CIRCLE card for more data

MANZEL

FORCE FEED LUBRICATORS

COST LESS...

than doing without them!



Pressure Application — Exact Amounts — Accurately Timed

* Manzel Force Feed Lubricators quickly save their cost by preventing breakdowns due to faulty or forgotten lubrication — by reducing the quantity of lubricants used — and by eliminating the labor of hand oiling. They keep vital parts properly lubricated for uninterrupted production efficiency round the clock.

You can have Manzel Force Feed Lubricators installed on present equipment or engineered into new machinery. Write for information.

Manzel

Professionally qualified engineering representatives throughout the country.

DIVISION OF

HOUDAILLE-HERSHEY CORP.

320 BABCOCK ST., BUFFALO 10, N. Y.

Circle 128 on READ-N-CIRCLE card for more data

new products

. . . starts on page 11

713-Convert ordinary conveyors to magnetic elevators

Converting existing belt conveyor lines to permanent, non-electric magnetic conveyors is simple with Magna-Rail units. Ferrous materials will not slip, slide, or fall off conveyors. They can be moved up inclines as steep as 75 to 80 degrees. Unit is a special circuit of powerful Alnico V magnetic castings, 4-in. wide, 1 15/16-in. high. Available in standard lengths of 3, 4, 5, and 6 feet. Other sizes on request. Units are simply placed under the conveyor belt as required. Comes in two strengths for speeds up to 85 fpm or for handling objects where contact with the belt is small and speed is greater. Completely non electric in operation. No outside power is ever required. No maintenance is ever required. Super magnetic elements are guaranteed to last indefinitely. Special units available for elevating large objects over turn from vertical to horizontal movement. ERIEZ MANUFACTURING COMPANY.

714-Portable indicator measures shaft and belt speeds

Portable speed indicator accurately measures shaft rotation speeds in rpm or surface movements in ft/min. Weighs only one pound. User merely

snaps on adaptor, applies it to surface to be measured, and reads meter. Available in a choice of adaptor sizes and meter ranges. SUN ELECTRIC CORPORATION.

715-Pipe-insulation jacketing withstands any treatment

New development in pipe-insulation jacketing for protection of hot or cold insulated lines, provides greater efficiency, wearing qualities, and ease of installation. Pip-Jac is made of preformed polyethylene. Resists damage from heavy blows from equipment and ladders. Will not chip, flake, rust or corrode. Smooth, even

surface holds up even when walked on. Will not take the contours of wrapping material on wrapped lines. No painting needed. Never becomes brittle. Assures lifetime service, free of maintenance. Salvageable jacketing is easy to handle. Precut to 6-ft lengths and preformed to correct diameter. Is merely fitted around the insulation, after which it springs shut by itself. Longitudinal seams are stapled. PIP-JAC COMPANY.

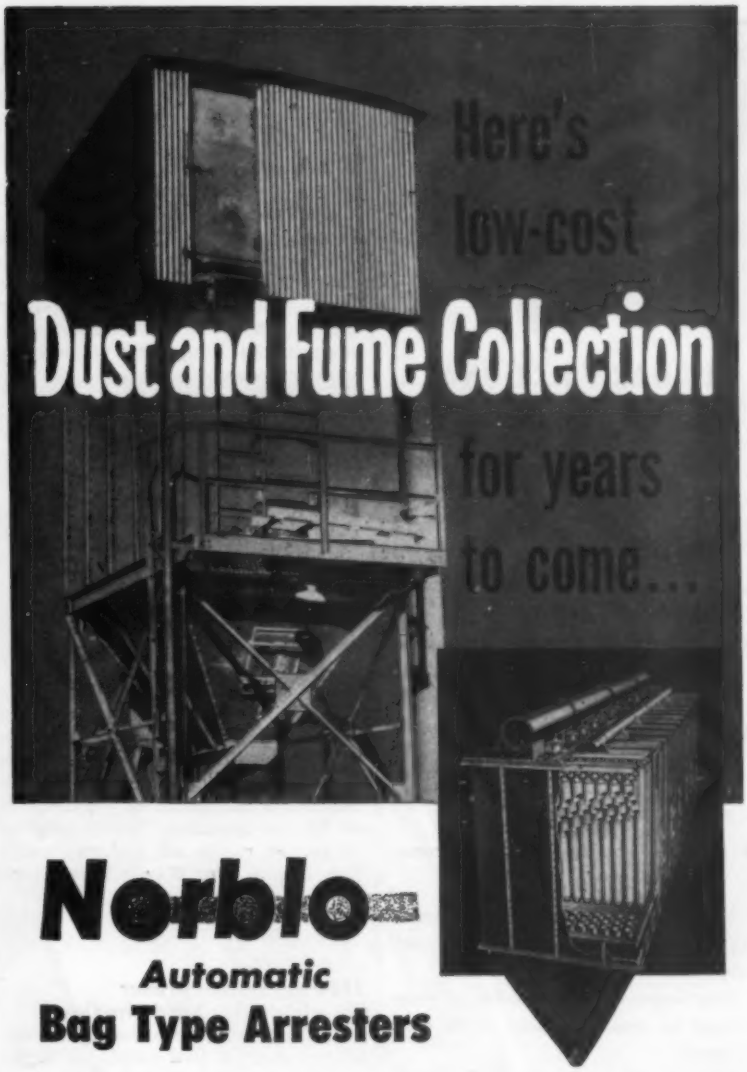
716-Improved cement for PVC piping

New solvent cement for joining PVC pipe fittings and flanges makes possible joints that are stronger than the pipe itself. Cement will bridge a greater diametral gap than previously available bonding agents. Cement is simple and economical to use. Ordinary paint brush serves as applicator. Cemented joints can be handled in an hour and reach working strength in 48 hours. Permits solvent welding of any SPI-approved piping of PVC. Saves on labor costs. Over 2000 ft of 3-in. PVC line can be installed in three man hours by unskilled labor. Almost completely eliminates possibilities of leaking joints. Comes in pints, quarts, and gallons. TUBE TURNS PLASTICS, INC.

(more new products on page 18)

FREE INFORMATION

For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card on page 69.



Norblo

Automatic

Bag Type Arresters

Norblo equipment is based on sound, experienced engineering and takes full account of the *scale* of your operation as well as *time* factors, so that Norblo performance can be *guaranteed.*

Norblo arrester design is based on multiples of a basic, standardized compartment. Bag cleaning—fully automatic—is cyclic and periodic, taking only a few seconds for each compartment. In continuous, heavy duty operation, full calculated capacity of Norblo equipment is always available, and investment for equipment of any desired capacity is held to a minimum.

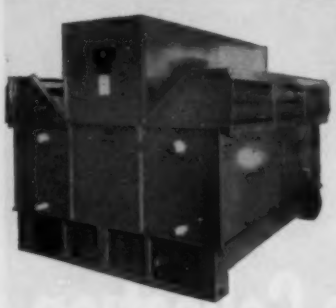
Norblo gives you all four essentials of low cost operation for years to come—advanced design, high efficiency, long life and low maintenance. Write for Bulletin 164-5.

The Northern Blower Company

Engineered Dust Collection Systems for All Industries

6422 Barberton Ave. OLympic 1-1300 Cleveland 2, Ohio

Circle 102 on READ-N-CIRCLE card for more data



NIAGARA SECTIONAL *Aero* HEAT EXCHANGER gives close temperature control, saves you LABOR, Power, Water

- **Because the new design improves the heat transfer to the out-door air by evaporation.**
- **Because new features keep your equipment working for long life with "new plant" efficiency . . . always full capacity.**
- **Because you save 95% of cooling water cost.**

You get faster, more accurate cooling of industrial fluids to specified temperatures.

You improve your quality of production by removing heat at the rate of input.

You save labor in upkeep. With full access to all interior parts and piping you see everything in easy inspections. You head off dirt accumulation and corrosion. Casing panels are removable without moving the coils. The coils can be cleaned from both sides.

First cost is low; freight is low because of the lowest space/weight ratio; you save much labor in erection. Capacity range is 7,000,000 to 18,000,000 Btu/hr. No other heat exchange method gives you so much saving in money and convenience.

Write for Niagara Bulletin No. 132

NIAGARA BLOWER COMPANY
Dept. I.P., 405 Lexington Ave.
NEW YORK 17, N. Y.
District Engineers in Principal Cities of U. S. and Canada

Circle 123 on READ-N-CIRCLE card

new products

. . . starts on page 11

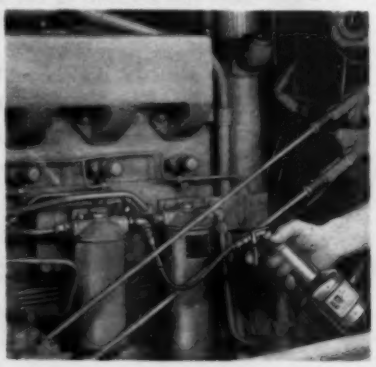
717-Powered dock ramp cuts costs all ways

Low-cost powered dock ramp combines a rugged, adjustable steel dock ramp and a power-activated mechanism in one compact unit. Installation costs are minimum. No piping, special wiring, or pit construction is required. Easily operated at mere flip

of a lever switch. Self-contained motor pump and activating mechanism located on under side of platform reduce installation costs and allow ease of maintenance. Integral tank requires a maximum of 5 gallons of oil for full operation. Travel range of 24 inches meets all highway truck floor heights. THE WAYNE PUMP COMPANY.

718-Fuel system primer eliminates hard starting

Fuel system primer for diesel engines insures a fuel supply throughout the fuel system before starting. Particularly valuable after engine or head overhauls. Eliminates danger of



damage to fuel injectors, fuel injection pumps, and nozzles. Reduces wear and tear on batteries, especially during cold weather. Can be attached from any position. KENT-MOORE ORGANIZATION, INC.

719-Industrial TV camera with remote control

Remote control of closed-circuit industrial TV equipment including camera, lens iris and focus, indoor and outdoor pan and tilt, and weatherproof housing is now available. Full 360-degree camera viewing and 90-degree tilt are obtainable with both indoor and outdoor mountings. Two

restyled camera control units, portable and wall-mounted, are also available with plug-in control panels that may be removed to provide remote operation of beam, focus, target, blanking, and gain. GENERAL PRECISION LABORATORY INCORPORATED.

FREE INFORMATION

For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card on page 69.

720-New fluorescent lamps have built-in reflector

Fluorescent lamps with internal reflector surfaces result in 70 percent more downward light. Particularly applicable in installations where dust and dirt are present. Sufficient improvements in lamp lumen-hours are obtained because the lamp is relatively unaffected by deposits of light-stealing dust and dirt on the top surface. This reduces lamp cleaning and maintenance costs. May be

mounted bare without external reflectors, even where ceilings provide very poor reflectance. Internal reflector covers more than half of the lamp's circumference. Presently available in 4- and 8-ft single-pin types. SYLVANIA ELECTRIC PRODUCTS, INC.

J. S. PRODUCTION UP 10% WITH . . .

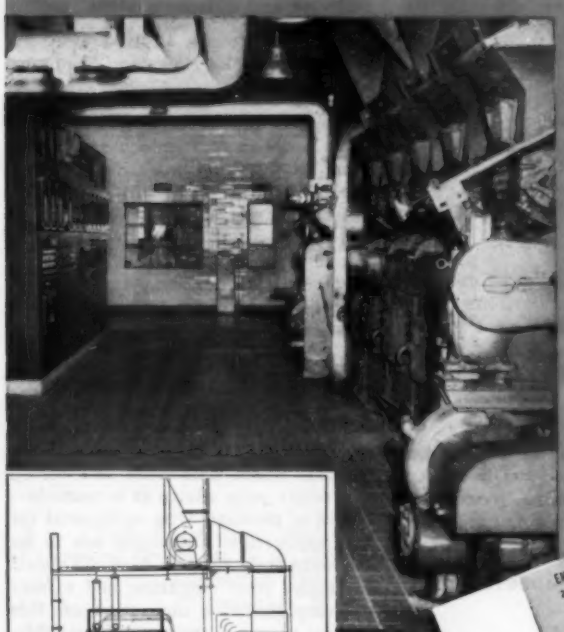
DETROIT ROTOGRATE STOKER

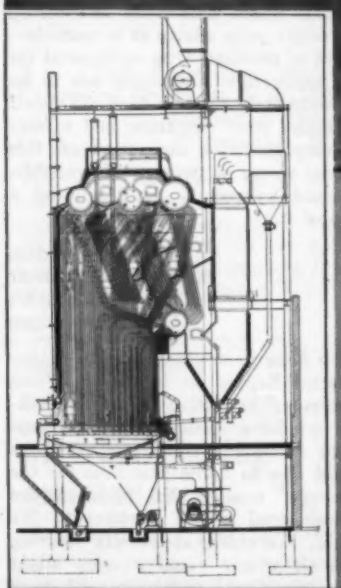
John Strange Paper Company, Menasha, Wisconsin Wins Power Modernization Award With New Steam Plant

• • •

Because so much steam is needed in paper making, the improved efficiency is reflected in a 10% increase in paper production. Since many costs remained the same, extra profits may be credited to the new steam generating equipment.

This includes a Union Type B four drum steam generator with superheater and economizer, fired by a Detroit RotoGrate Stoker. Capacity 165,000 pounds of steam per hour at 725 pounds pressure, 825° F temperature.





ENGINEERING and MANAGEMENT SECTION
John Strange Paper Co's modernized power plant is an outstanding example of . . .
Planning power services around a process

Cummins & Bernard Inc., Consulting Engineers, Ann Arbor, Michigan, also received a citation from Power.

Write for reprints of this article.

Power MODERNIZATION PROGRAM

7380

DETROIT STOKER COMPANY

GENERAL MOTORS BLDG. • DETROIT 2, MICHIGAN

Circle 118 on READ-N-CIRCLE card for more data

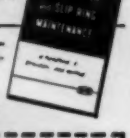
Keeps motors running like new... The easy, fast way to restore commutators and slip rings — WITHOUT DISMANTLING! — Substitutes low-cost prevention and correction for high-cost repair and rebuilding — COSTS LITTLE, SAVES A LOT.

RESURFACERS
Refinish commutators and rings to like-new condition even when ridged, scored or burned.

MICA UNDERCUTTERS
Stop sparking — help commutation — prolong brush life. For all sizes of commutators.

PRECISION GRINDERS
For more than surface smoothing—under machine's own power. Accurate to .001".

FLEXIBLE ABRASIVE
Cleans and burnishes commutators. Non-dusting. Complete size range.



FREE 39-page Handbook — Complete information on commutator maintenance. MAIL COUPON.

IDEAL Products Are Sold Through Leading Distributors

IDEAL INDUSTRIES, Inc. (IDEAL)
1023 Park Avenue, Sycamore, Illinois
Send FREE HANDBOOK and information on
☐ Resurfacers ☐ Undercutters
☐ Precision Grinders ☐ Flexible Abrasive
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COMPANY_____
TITLE_____
ADDRESS_____
CITY_____ ZONE____ STATE_____

Circle 132 on READ-N-CIRCLE card

our readers write

. . . to industry & power

We are gratified

Gentlemen:

Thank you for the recent issue of INDUSTRY & POWER showing future forecasts for the Power Industry, including air pollution, incineration, etc. You've done an excellent job on making this forecast and I doubt if anyone will take strong issue in that which you predict.

This was a most comprehensive statement of all the facets of power forecasting and for the space that's allotted to this type of thing, I think you did a grand job. We are going to publish an announcement of this forecast in one of our publications in the very near future. This may cause some to look into your magazine for the information who otherwise might not have the opportunity to see it. Keep up the good work.

Harry C. Ballman
Executive Secretary
Air Pollution Control Association
Pittsburgh, Pa.

We don't handle the movies

Gentlemen:

We would like to have films listed in INDUSTRY & POWER. . . . We have a 16 mm sound projector, and our membership consists of men from fireman to chief engineers. . . . We would like to have these films for March 22.

Edward Pierce
Fitchburg Association No. 20
of Massachusetts
National Association of Power
Engineers

● *We advised Mr. Pierce, in ample time to arrange his meeting program, that requests for booking films listed in* INDUSTRY & POWER *are best made directly to the company sponsoring the film.*

Not quite so exclusive

Gentlemen:

I noticed in your January, 1956 issue of INDUSTRY & POWER in the "spot news" section a paragraph entitled, "Exclusive System Offers More Efficient Water Softening." It might interest you to know that we have been building an all-copper system which performs the same functions as described for over 30 years.

I thought you might be interested in the attached tear sheet covering our collector and diffuser system.

Joseph H. Hewetson, Jr.
The Hewetson Company
Cincinnati, Ohio

● *Apparently, there is some discrepancy between that which is "exclusive" in function and that which is "exclusive" in method of achieving function. Uniform distribution of water flow through the softener bed is a function desired by all. Methods for achieving this do vary, and this accounts for the claim to exclusiveness printed in our January issue.*

"Package" waste treatment?

Gentlemen:

I am involved on a problem of industrial waste treatment and would appreciate your advice as to manufacturers of package-type equipment for this application. Capacities are to be approximately 75 gpm. Also, if I recall correctly, your magazine had a fairly comprehensive discussion on this subject a year or two ago. If available, I would appreciate your sending a copy of it.

Sigman Gendein
Mechanical Engineer
Corps of Engineers
Detroit, Michigan

● *We have sent along a copy of our "Special Report on Industrial Waste Treatment" as well as all the information we have available on package waste treatment equipment. But we would like to know just how far the "package" concept has been carried in industrial waste treatment. We would, therefore, appreciate hearing from all of our readers who might have experience to report with such "package" industrial waste treatment systems.*

Nice words

Gentlemen:

I received this morning a tearsheet of your new cover design. It is excellent, superb and impressive, and I would like to take this opportunity to congratulate you and the artist on it.

In this connection, I would like to

tell you that I enjoy reading INDUSTRY & POWER tremendously, and it is, in my opinion, the number one publication in its field. I wish you continued great success.

Maurice Feldman
New York, New York

Gentlemen:

I proffer my verbal commendations in recognition of the admirable engineering and journalistic standard maintained by your publication.

Joseph B. Warnalis
Bristol Engineering Corp.
Bristol, Pa.

Licking peeling

Gentlemen:

Reference is made to the December issue of INDUSTRY & POWER in which an article, "Plastic Paint Stops Peeling Problem," appeared on page 66 under the monthly feature, "Ideas in Action."

It will be appreciated if you will furnish this office the address of the Maintenance Coatings Company, who, as stated in the article, are manufacturers of a macrylic plastic coating.

T. J. Hewitt
Chief, Engineering Division
Corps of Engineers, U. S. Army
Wilmington District
Wilmington, N. C.

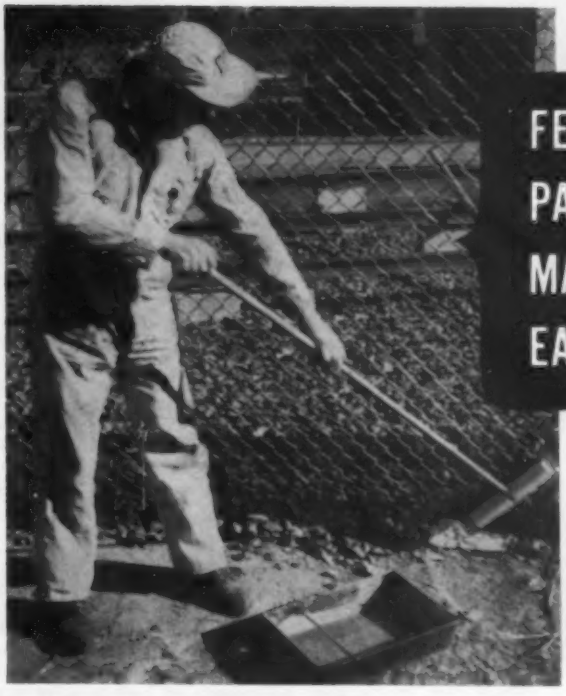
• *Macrylic plastic coating is manufactured by Maintenance Coatings Company, 141 Broadway, New York, N. Y. Acrylic emulsion for this coating is manufactured by Rohm & Haas Company of Philadelphia.*

next month in
INDUSTRY & POWER

air conditioning maintenance

Get ready for your summer chores by reading how one plant cuts air conditioning maintenance labor hours by 25 percent. Downtime and maintenance costs are similarly cut. This plant's experience with year-round air conditioning can save you money for whatever length of season you have. Read about it in the May issue of

INDUSTRY & POWER



FENCE PAINTING MADE EASY

Subox makes fence painting easy and economical.

Subox paints are so simple and quick to apply that you can put them on by spray or roller coating methods — but for the fastest and most satisfactory results use an ordinary floor broom!

Subox paints are the only paints in America made with *suboxide of lead* — one of the most effective rust-inhibitive and anti-corrosive agents known. In addition, being a heavy colloidal pigment, it prevents spattering when applied to wire mesh. Subox goes on smoothly, evenly, thoroughly and adheres closely.

Next time use Subox. It costs no more than other paints and endures for many years. Comes in a wide variety of decorative colors.

Detailed instructions for easy, economical fence painting are contained in the booklet, *"Simplified Fence Painting"*. Send for a copy.

Subox Inc.

Established 1924
9 Fairmount Plant, Hackensack, N. J.

See Catalogues in Sweet's Industrial and Engineering Files.

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new bulletins

. . . just circle key numbers on READ-N-CIRCLE card on page 69

400-How to control heat radiation

Bulletin CA-12 tells how to determine proper control system for direct radiation. Includes charts and graphs for control of steam and hot water. Discusses both two-positioning and proportioning modes of control. Gives information for selecting controls for direct radiation. Four pages. BARBER-COLMAN COMPANY.

401-Pumps for every purpose

Positive displacement rotary pumps for every industrial use are described in detail in Bulletins 100 to 105. Includes a wealth of information on operating capacity, performance curves, installation dimensions, and details for direct and V-belt drives. Pump sections are shown with parts lists for ordering replacement parts. TUTHILL PUMP COMPANY.

402-Transformer oil is fireproof

Liquid-filled transformers using fireproof insulating liquid are described in Bulletin 61B6043. Fireproof liquid reduces fire hazards, eliminates costly vaults, and permits safe indoor installation. Describes complete line of transformers available in ratings from 3 through 15,000 kva. Four pages. ALLIS-CHALMERS MANUFACTURING COMPANY.

403-Compactness in motor control

A general-purpose motor control center that permits savings of up to 50 percent in floor area is described in Bulletin GEA-6367. Lists ratings, weights, dimensions, installation data, and specification forms. Space-saving construction permits use of up to nine NEMA Size 1, or six NEMA Size 2 units in one 90-inch-high vertical section. Designed to accommodate starter units in either fuseable or circuit-breaker type. Twenty-four pages. GENERAL ELECTRIC COMPANY.

404-Small package air conditioners

Here's information on a versatile small, unit that can be used for almost any commercial or industrial installation. Bulletin C-1100-S105-P gives details on either floor or ceiling mounting, use of any three sides as air inlet or discharge, and how to assemble in separate sections to fit any individual space requirements. Four pages. WORTHINGTON CORPORATION.

405-Dehumidify your storage areas

Answers to your storage dehumidification problems are contained in Bulletin DS-1. Discusses location of units, load, humidity control, and gives application recommendations. Schematic diagrams are included showing typical installations and piping. Eighteen pages. DESOMATIC PRODUCTS, INC.

406-High-pressure rotameter kit

High-pressure rotameter kit for safe use at pressures up to 3000 psi at 200 F is described in Bulletin 140. Includes tables giving range, float material, and flow rates for the complete line of kits. Contains information on how to solve rotameter problems quickly and easily. Eight pages. BROOKS ROTAMETER COMPANY.

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Engineering data on all phases of piping including lateral, axial, and angular traverse plus thermal expansion tables for steel, cast iron, wrought iron, and copper pipe, are included in Bulletin No. 53. Lists complete line of expansion joints in sizes from 3 to 48 inches. Also contains data on copper-ring and stainless-steel-ring controlled flexible joints in both welding and flanged end. A worthwhile addition to the library of all engineers concerned with piping problems. Twenty-six pages. COOK ELECTRIC COMPANY.

407-Plastic blowers stop corrosion

Eliminate expensive repair and replacement—use centrifugal blowers constructed entirely of plastic. Bulletin 102 describes complete line of blowers in four impeller diameters with capacities from 143 cfm to 7722 cfm. Includes chemical resistance charts for 350 chemicals that provide comparison of plastic to other construction materials. Plastic used for needle valves, piping systems, duct systems, and machine parts is also described. Twenty pages. INDUSTRIAL PLASTIC FABRICATORS, INC.

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413-Convertible condensate pumps

Close-coupled bronze-fitted condensate pumps are easily converted from single to duplex units. Bulletin 1460 de-

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1,286 Plants in 48 States and 14 Foreign Countries

Insure Insulation Efficiency with Childers Jacketing

Leading engineers world-wide specify Childers Jacketing for protecting costly insulation on lines, towers, vessels and tanks. These efficiency minded engineers prefer Childers Jacketing because of these exclusive features:

1. LAP-SEAL (patents pending) insures a more positive weather-seal.
2. Heavy weight jacketing designed for lines subject to abuse.
3. Deep Corrugated Jacketing with factory-attached moisture barrier for towers, vessels and tanks.
4. New resin adhesive that makes a stronger bond between the jacketing and the vapor barrier.

Childers Aluminum Jacketing provides strong, durable protection with three way savings:

1. Lower first cost than any other permanent jacketing.
2. Lower application cost because it's so easy to cut-to-size and attach.
3. Eliminates maintenance because it is made of durable aluminum for maximum corrosion resistance and requires no painting.

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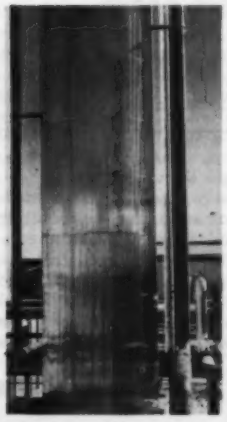
You can help increase the efficiency of your insulated lines, towers, vessels and tanks by using Childers Jacketing. Write today for free sample and engineering data. Childers Manufacturing Co., Dept. IP-9 Houston 8, Texas.



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Heavy Weight Jacketing

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Lap-Seal has 2 important advantages:

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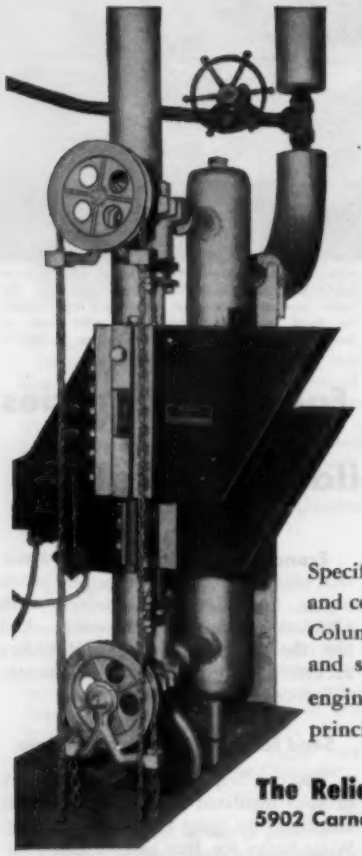
Reliance Water Columns

Gages and Safety Specialties assure you the utmost in *Dependability*



Since 1884, Reliance has maintained leadership in Boiler Safety Device development and manufacture. Water Columns with automatic Alarms, operated by the original *instantaneous* alarm mechanism, have helped to fortify power plants against the consequences of boiler water failure for billions of operating hours. Whistle alarms are available on columns for pressures to 900 psi; electric alarms, actuated by Reliance Electrode Levalarms, to 2500 psi.

For higher pressures — to 2500 psi — Reliance standard and custom-built equipment embodies principles of design and construction perfected in 70 years of *specializing* in this field—"super-rugged" Water Columns built with a generous margin of safety and tested at twice rated capacity.

Specified by many boiler manufacturers and consulting engineers, Reliance Water Columns exceed requirements of national and state code authorities . . . Reliance engineer representatives are located in all principal cities. Write for Bulletin 516.

The Reliance Gauge Column Company
5902 Carnegie Avenue • Cleveland 3, Ohio

Reliance Water Column Accessories, and Specialties

Water Gage Valves Gage (try) Cocks
Gage Inserts: Prismatic, Mica-protected Flat Glass, "Micasight"
Direct-to-Drum Water Gage Assemblies
Complete Line of Water Gage Illuminating Equipment
EYE-HYE Remote Reading Water Level Indicator — all pressures
Levalarms — Float-type Liquid Level Alarm Devices
Levalarms — Electrode-type Liquid Level Alarms, Fuel Cut-out and Pump Control

The name that introduced safety water columns....in 1884

Reliance®

BOILER SAFETY DEVICES

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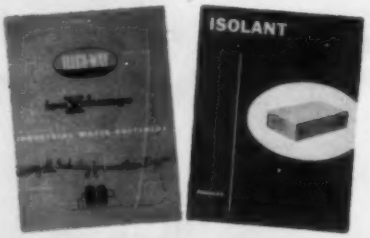
new bulletins

. . . starts on page 22

scribes construction, specifications, and optional equipment. Pump inspection can be made by simply removing three bolts. Includes chart giving capacity for units at various discharge pressures for both single and duplex units. Four pages. SARCO COMPANY, INC.



414-Simplify water treatment

All information needed to accurately select water treating equipment for any plant, industry, or other institution is contained in this bulletin. Three basic types of exchange materials are described, including water and brine distribution mechanism and exchange material depth. Sketches show direction of water and brine flow during service, brine-rise, and regeneration cycle. Contains specifications including flow rates, exchange capacities, amount of salt, and shipping weight. Eight pages. ILLINOIS WATER TREATMENT COMPANY.

415-Isolate your vibrations in air

Vibration control material made of millions of hermetically sealed air cells is described in Catalog IS-55. Describes how material expands or contracts with applied load, thereby isolating combinations of vibration, shock, and noise on a cushion of air. Discusses how sealed dead air spaces provide a sound barrier with marked noise reduction. Includes types and load ranges, from 400 to 6000 lb/sq ft. Four pages. T. R. FINN & COMPANY, INC.

FREE COPIES

For free copies of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card on page 69.

416-Robot logger is automatic

Bridging the gap between instrumentation and automation, automatic loggers are revolutionizing process instrumentation. Bulletin 58-401 gives technical data and block diagrams for automatic loggers, and includes description of all equipment. Includes measuring circuits, pneumatic transducers, plus formulas

and calculations for solving automatic intelligence gathering systems. Describes how automatic data handling eliminates costly manual data handling and how better quality control increases production. Six pages. FISCHER & PORTER COMPANY.

417-Automatic materials weighing

Automatic equipment for weighing bulk materials is described in Bulletin 8946A. Units are designed for handling dry, ground, granular, dusty, and non-free-flowing materials. Diagrams are included showing gravity, belt, screw, and vibrating feed arrangement. Includes special equipment such as locking gear, automatic compensation mechanism, and automatic tabulator. Six pages. RICHARDSON SCALE COMPANY.

418-Are you using V-belt drives?

Here are answers to questions relating to basic principles and practices in engineering and use of multiple V-belt drives. "Modern Multiple V-belt Drives," Bulletin 20E8297 tells how to engineer V-belt drives. Provides tables and data. Describes modifications in V-belt drives. Thirty-six pages. ALLIS-CHALMERS MANUFACTURING COMPANY.

419-Safe walkways prevent skids

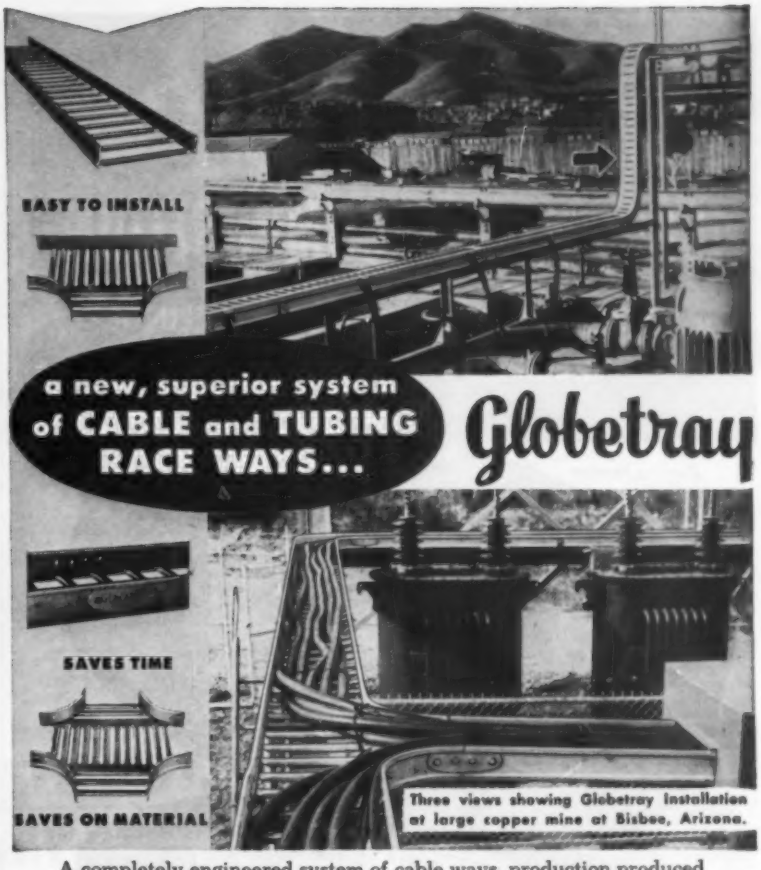
Nonskid, safety grating for floors, work platforms, stair treads, landings, and general walkway construction are listed in this bulletin. Includes design load capacity tables for both steel and aluminum in sizes to meet all installation problems. Illustrates flexibility of grating assembly to satisfy your needs. Twelve pages. THE GLOBE COMPANY.

420-Synthetic fluids flow freely

Many uses of Ucon synthetic fluids and lubricants are contained in Booklet 6500D. Gives properties, applications, and characteristics for use as mechanical lubricants, hydraulic fluids, heat-transfer fluids, antifoam agents, solvents, and formulation components. Available in viscosity ranges from 50 to between 60,000 and 90,000 SUS at 100 F. Lists high viscosity indexes, low pour points, and excellent lubricity. An excellent addition to the reference library of all engineers. Fifty-two pages. UNION CARBIDE AND CARBON CORPORATION.

421-Solve cone-drive gear problems

How to assemble cone-drive double enveloping gears is explained in Bulletin CA-55. Discusses controlling dimen-



A completely engineered system of cable ways, production produced and die formed for uniformity with up to twice the strength of ordinary trays, by actual laboratory tests. The universal splice plate joins all parts through the side channels only. All curved fittings are joined at the end of the radius (no tangent material is required) permitting continuous curves. This feature provides greater flexibility of application in tight places and creates an endless variety of combinations for a simple solution to any design problem of change of direction or elevation with a complete set of standard fittings.

Comes in 6", 12", 18" and 24" widths, in standard 12' lengths to further speed up installation time. Cable way can be cut to length at any point – insides and bottom always smooth – all sections punched for easy installation – perfect fit at all times. Neat, clean and uniform in appearance.

Write for new complete catalog. Distributors in all principal cities. Contact the Grip-Strut distributor under "Conduits" in the classified telephone directory.

Manufacturers Since 1914 The GLOBE Company

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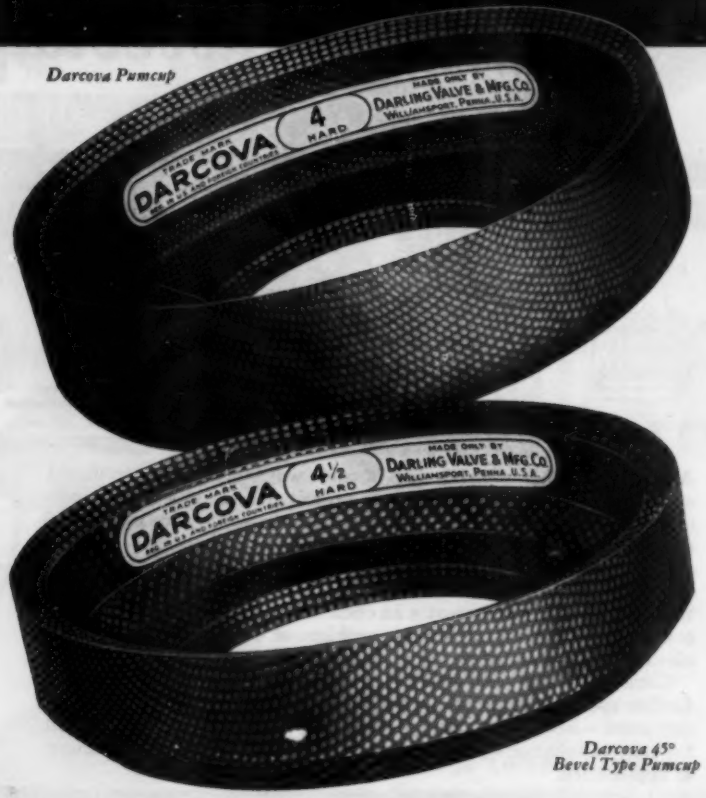
DARCOVA PUMCUPS

now available with

100% NYLON COMPOSITION

for HYDRAULIC CONTROLS, AIR CYLINDERS, RECIPROCATING PUMPS



Darcova Pumcup

Darcova 45° Bevel Type Pumcup

DARLING Pumcups—long noted for unequalled efficiency and life in all kinds of cylinders—are now greatly exceeding their own performance records! The new 100% Nylon Composition, available *only* in Darcova Pumcups, does it!

Nylon Pumcups are made in sizes, types and textures exactly right for your particular equipment—ready *now* to give you unprecedented piston packing performance!

Write for helpful data Bulletin No. 5503.

DARLING VALVE & MANUFACTURING CO.

Williamsport 9, Pa.

DARCOVA — THE ORIGINAL COMPOSITION CUP

TRADE MARK PUMCUPS

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new bulletins

. . . starts on page 22

sions, adjustment of bearing play, errors in angularity, and running-in practices. Illustrations show correct and incorrect tooth contact patterns. Includes recommendations for correcting many common faults. An excellent manual on power transmission gearing. Twelve pages. CONE-DRIVE GEARS DIVISION, MICHIGAN TOOL COMPANY.

FREE COPIES

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422-Rectifiers regulate reasonably

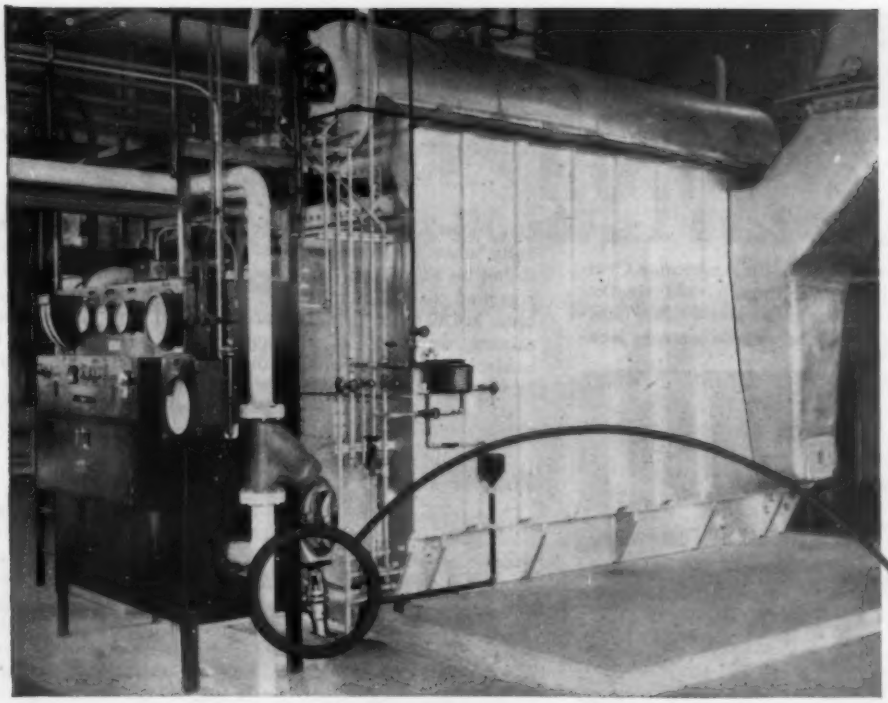
Germanium rectifiers that have nonaging operating efficiencies up to 95 percent are described in Bulletin GR135. Discusses complete line in capacities from 500 to 50,000 amperes, in either forced air or completely sealed water-cooled units. Rectifiers give more power in less space and constant high efficiency over years of continued use. Four pages. BART-MESSING CORPORATION.

423-Direct-operated valves

Bulletin 1009 describes direct-operated water pressure reducing valves for industrial installations. Valves are recommended for intermittent flow and flows subject to abrupt fluctuation. Gives recommendations for use with fast-acting equipment. Includes capacity table and installation recommendations. Four pages. SPENCE ENGINEERING CO., INC.

424-Magnetic brake adjusts itself

Self-adjusting magnetic brake suitable for all types of dc motors is described in Bulletin B-6548. Describes construction details, operation, and applications, with recommendations for reducing maintenance costs. Illustrations show clutch action, brake clamping action, and brake releasing action for heavy-duty application. Includes torque-rating chart for series-wound motors, giving proper brake to use for torque requirements. Brakes can be adapted for ac motors by using a rectifier. Eight pages. WESTINGHOUSE ELECTRIC CORPORATION.



COMBUSTION ENGINEERING ADOPTS YARWAY SEATLESS BLOW-OFF VALVES FOR PACKAGE BOILERS

Combustion Engineering, Inc. on this package boiler installation at the Orangeburg Pipe Plant in California, again includes Yarway Seatless Blow-Off Valves as part of the "package."

It's a popular idea—and growing fast. All *good* package-type boiler installations are *better* when equipped with Yarway Seatless Blow-Off Valves.

More and more boilermakers are standardizing on Yarways, and more and more boiler users are expecting the advantages of Yarway Blow-Off Valves on their package units.

Get the full story on why more than 15,000 boiler plants use Yarway Blow-Off Valves, some for 30 to 40 years.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

Yarway Type "B" Seatless Tandem Blow-Off Valve. Note balanced sliding plunger design with no seat to score, wear, clog or leak. Pressures to 400 psi.

YARWAY **BLOW-OFF VALVES**

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ideas in action

. . . for industry & power

Railroad to the rescue

When a boiler broke down in the Lunkenheimer Company's heating plant, it looked as though cold weather would force partial closing of the plant and offices. However, the B & O Railroad immediately made a steam loco-

motive available. Maintenance crews worked overtime to convert the locomotive for service as an auxiliary power plant. Locomotive was pulled alongside the plant and pipe fitters connected the auxiliary power plant to the process steam and heating system. Thanks to the railroad's cooperation, work was resumed under normal conditions.

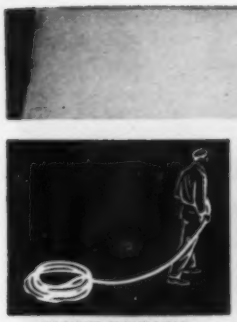
Electronic scale withstands vibration

An electronic device which automatically weighs bulk materials as they pass on a conveyor is extremely accurate despite wide temperature variation, vibration, sudden radical changes in load, or the presence of dust or dirt. Another advantage over nonelectronic continuous-weighing devices is that the "Electro-Way" is considerably lighter, smaller, and more compact. New alloy, called Ni-Span C, which is unaffected by temperature changes through a range of 200 F, is key to the continuous weigher, made by Commercial Products Division of Bell Aircraft Corp. Rugged dependability and high accuracy stem from the elimination of complex beams, balances, and mechanical linkages in favor of a single large spring made of this new alloy, plus electronic connections. Ni-Span C always maintains the same elasticity without the temperature compensation devices usually required in such systems. Electronic measuring equipment, housed in a box about two cu ft in volume, can be located remotely if desired. Measurements are shown on a Veeder-Root or similar counter, recorded on a 24-hour chart, or both. The scale can be set so that it stops the conveyor system automatically when the counter registers a given total weight, or it can be harnessed to insure delivery of no more than a specified weight per hour. When several conveyor systems are used to bring different ingredients together for mixing, weighers on each system can be interlocked to control the proportions of the mixture. Entire mechanism weighs only 350 pounds.

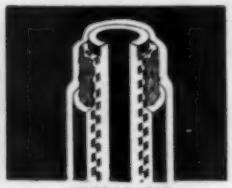
Plastic sheets cure water seepage

Water seepage of 2 to 3 gpm in a 5000-gallon concrete coolant tank at Logan City Diesel Plant, Logan, Utah has been stopped quite simply. Concrete tank, 21-feet long by 6-feet wide and 6-feet high, was built about 30 years ago as part of the diesel electric plant foundation. Hot water from diesel engines is mixed with cold water, then returned to cool the engines. Sharp temperature differences inside and outside the tank caused severe cracking in walls and floor. Water seeping from the tank widened the cracks and contributed to uneven settling of its foundation. Seepage loss grew so bad that when the engines

were shutdown for six hours, water level would drop to a point where the circulating pumps lost their prime. A costly process of grinding the cracks into V-shaped troughs and filling them with water-resistant material was not very successful. A lining of Krene, made by Bakelite



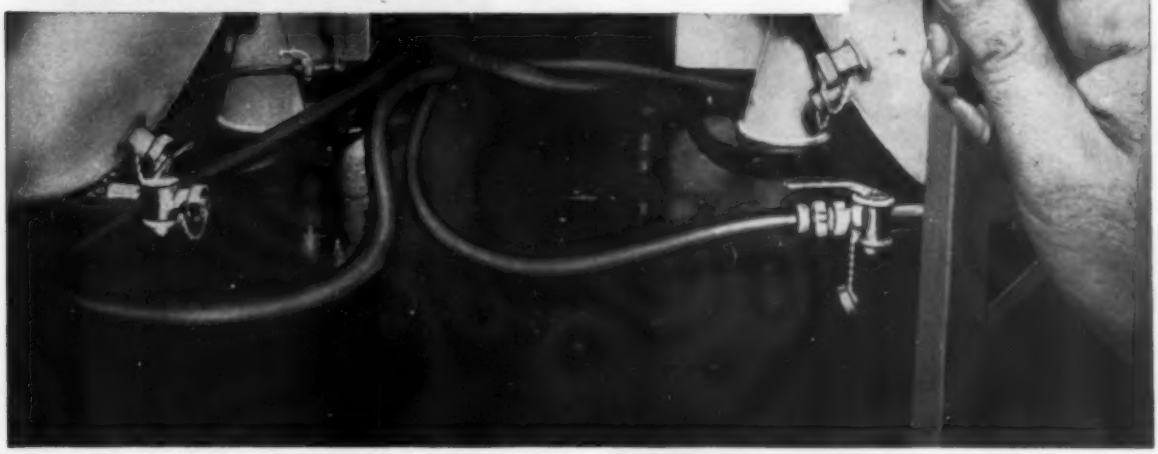
EASIEST HANDLING HOSE MADE



INSEPARABLE TUBE-TO-COVER BOND

HOW HOMOFLEX HOSE

gives you "More Use per Dollar"



Many Users Say This Hose Outlasts Them All!

Bulk and stiffness have been engineered out of this modern hose. An exclusive R/M construction, Homoflex Hose has no pre-set twist . . . it coils and uncoils freely in any direction, eliminating strain at kinking points that can cause internal damage and eventual hose failure. Special engineering creates a homogeneous, inseparable tube-to-cover bond that greatly increases hose life . . . and reduces hose costs! Rugged and strong, flexible as a rope, and light, Homoflex Hose does a *better* job in handling air, water, and other fluids and gases . . . and it lasts longer.

Homoflex Hose maintains uniform inside and outside diameters for faster flow on the job . . . easier fitting of couplings. Ask your R/M representative about types of Homoflex Hose for your operations. He can also show you how other types of R/M Hose for general and special purposes last longer, too . . . give you "More Use per Dollar."

DH-611

R/M

MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

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V-Belts

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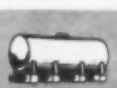
Hose

Roll Covering



Tank Lining

Abrasive Wheels

Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings Asbestos Textiles • Packings • Engineered Plastic, and Sintered Metal Products • Laundry Pads and Covers • Bowling Balls

Circle 140 on READ-N-CIRCLE card for more data

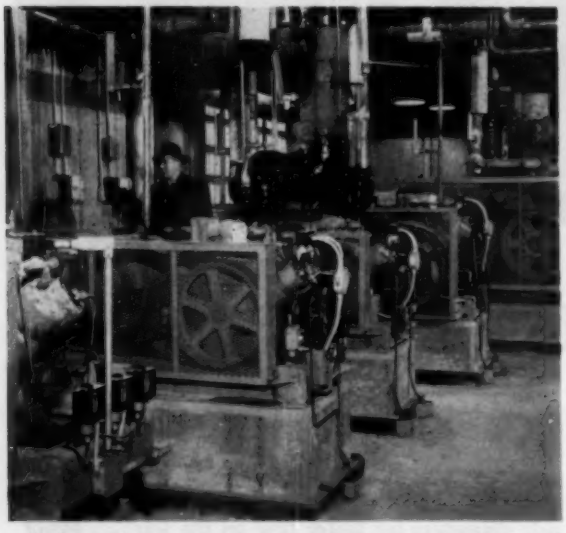
ideas in action

. . . starts on page 28

Company 0.020-in. thick, was made to fit inside the tank, and suspended by redwood strips bolted to the top of the tank walls. Flanges were placed around pipes projecting into the tank to form a tight seal with the lining. Now, the water level drops only about ½ inch in a six-hour period—and this is attributed to valves and pipes of the tank outlet system.

Two compressors serve five cold rooms

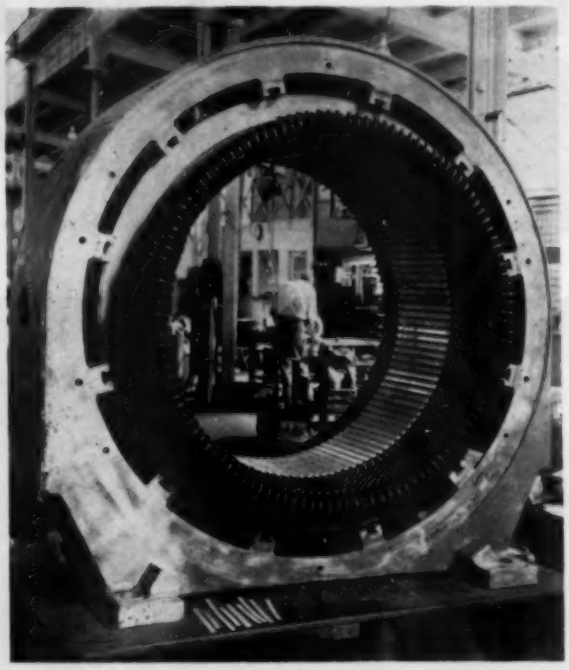
Two compressors (13 hp and 20 hp) control five deep-freeze rooms at Manhattan State Hospital, Ward's Island, New York. Low temperature rooms are maintained at temperatures of 10 F and −20 F. Defrosting is automatically controlled on each compressor by a Tork Switchmaster time switch. Defrost cycles ranging from 2 to 55



minutes and accurate to any 1-minute period adjustment are possible at any time. This is necessary because the defrost time for the rooms may vary, depending on the volume stored. Each compressor is controlled by a separate switch, so the schedule for all five need not be the same. Individual compressors are timed according to their specific needs.

Longer life for rewound motor coils

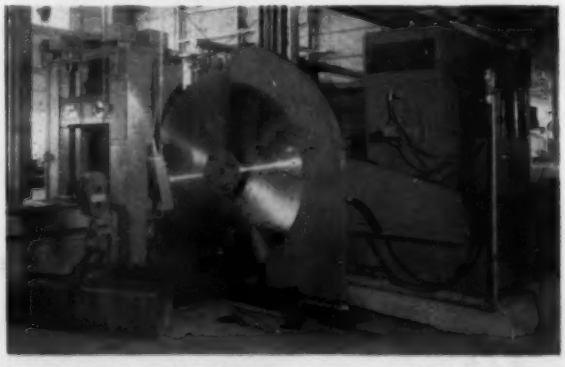
New insulation for large motors and generators will increase service life of rewound coils as much as five times. Insulation is a durable laminate of glass cloth and mica-filled plastic, based on Bakelite epoxy resin. Larsen-Hogue Electric Co., Los Angeles, developed the method to alleviate motor burnout problems in rubber plants. Fine carbon black particles adhere to coil surfaces and work their way into microscopic crevices in conventional coil insulation. After only a few weeks, a sufficient deposit builds up to ground and short out motor. Nearly 75 percent of burnout repair costs are for downtime, removal, and reinstallation charges. Resin provides a dense seal of dielectric material with none of the voids of conventional coil insulation. It is impervious



to moisture, acids, alkalies, oils, and most solvents. Resin is also an excellent adhesive. When formed under high temperature and pressure, the plastic and glass-cloth laminate is permanently bonded to the copper conductor.

Giant circular saw powered with adjustable-speed drive

Adjustable-speed drive powers a seven-foot circular saw at a US Air Force plant in Cleveland operated by the Aluminum Company of America. Blade rotates at speeds up to 46 mph. It slices aluminum forging ingots. Some ingots are almost 3½-ft thick. Saw is powered by a General



Electric unit-cooled dc motor. Unit-cooler is an integral part of motor. It operates on a heat-exchanger principle to protect motor from metal dust thrown off by blade. Variable-speed drive gives speed range from 1360 to 4100 surface ft/min. Different speeds were previously obtained through gear changes.

(*more ideas in action on page* 64)

COOL HEADS IN "HOT SPOTS" WON'T LET YOU DOWN

On jobs where the air is foul or hot, men can't be blamed too much for letting up now and then. If you want to keep their efficiency and morale high, feed them better air.

Employers have learned the value of putting Coppus Blowers and Ventilators on the job . . . in confined areas and near furnaces or hot processes. The men work faster, do better work, work longer without fatigue — and appreciate the more comfortable working conditions.

Give some thought now to the "hot spots" in your plant. There is a Coppus Blower for practically any requirement — Cable Manhole and Tank Ventilators, Boiler Manhole Blowers and Exhausters, Heat Killers, Shiphold Ventilators, etc. The Coppus "Blue Ribbon" is your assurance of design and construction planned for plenty of severe service. Check and mail the coupon for specific information. Coppus Engineering Corp., Worcester 2, Mass. Sales Offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG.

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- ☐ in underground cable manholes.
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- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.

COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
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- ☐ exhausters, welding fumes.
- ☐ stirring up stagnant air wherever men are working or material is drying.

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(Write here any special ventilating problem you may have.)

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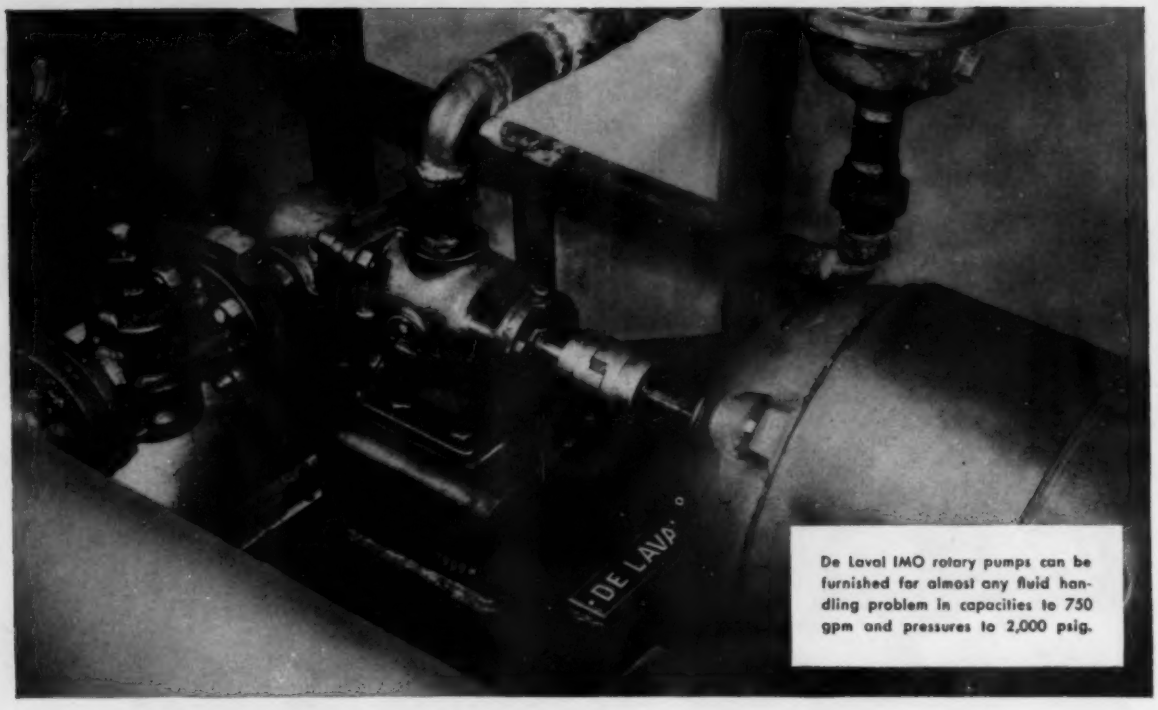


De Laval IMO rotary pumps can be furnished for almost any fluid handling problem in capacities to 750 gpm and pressures to 2,000 psig.

What to Look for in a Rotary Screw Type Pump

By W. J. MONGON, *Assistant Chief Engineer*
De Laval Steam Turbine Company

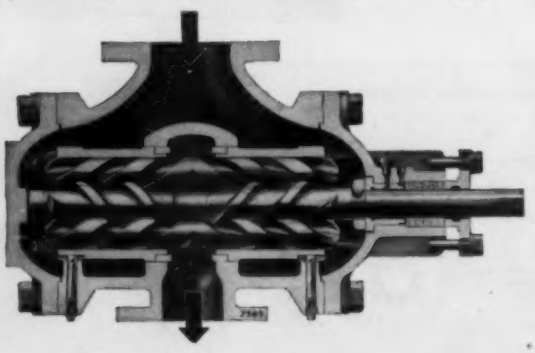
A sound knowledge of design, and how it affects performance, is the best insurance a buyer can have that he will get the pump he needs. This brief analysis of the IMO, a rotary three-screw pump manufactured by the De Laval Steam Turbine Company, will give you some of the necessary facts.

What qualities should you look for in a rotary type pump? It must, of course, meet specified capacities and pressures. But, it must also be efficient, operate quietly, stay on the job.

The axial flow of a screw type pump, and the resulting low inlet losses for any given pump speed, are important benefits that should be considered in making pump selections. The absence of timing gears and other mechanical features of construction also enable the De Laval IMO pump to operate at direct-connected motor and turbine speeds . . . to handle viscous liquids and high suction lifts.

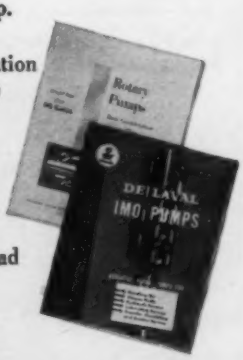
One of the most important features of the IMO pump is the hydraulic turning of the idler or sealing rotors. The central or power rotor is the pumping element; the liquid pumped turns the sealing rotors.

A screw type pump is well suited for applications where pulsation-free flow is desirable. The axial flow of the liquid without trapping and the unique thread form which keeps closures fluid-tight contribute to quiet operation of the IMO pump.



This is a cross-section of the De Laval IMO Series A322A, a positive displacement rotary screw type pump.

Catalog LS gives useful application and specification data on the IMO pump. An article titled, *Rotary Pumps, Basic Considerations in Their Application*, contains a description of rotary pumps in general. For these publications, write on your company letterhead to De Laval Steam Turbine Company, 857 Nottingham Way, Trenton 2, New Jersey. DL-361



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this month's comment . . . .

we waste most what we need most

Down on the campus of my Alma Mater they tell the story these days about the firm that sent out a team of 15 recruiters to round up some engineering talent. Only 12 returned. A competitor had hired the other three.

Recruiting engineering talent has indeed come a long way since the days of most of us went out after our first job. For example, these are some of the come-on's dangled before young graduates, and indeed mature engineers:

- recreational programs for year-round enjoyment of the entire family (work where it's *fun to live*)
- live in Dayton (or New England, or Cocoa Beach, or Arizona)
- paid holidays, paid sick leaves, and paid vacations
- fringe benefits, including pensions and group insurances

Graduating seniors have lush pickings. Many have been invited on all-expense-paid trips to audition prospective employers on their home field. During the Spring vacations, you'll find hundreds of them flying from coast to coast, jamming as many whirlwind joy rides as they can into one week. And these green grads will start their professional careers at anywhere from $400 to $500 per month.

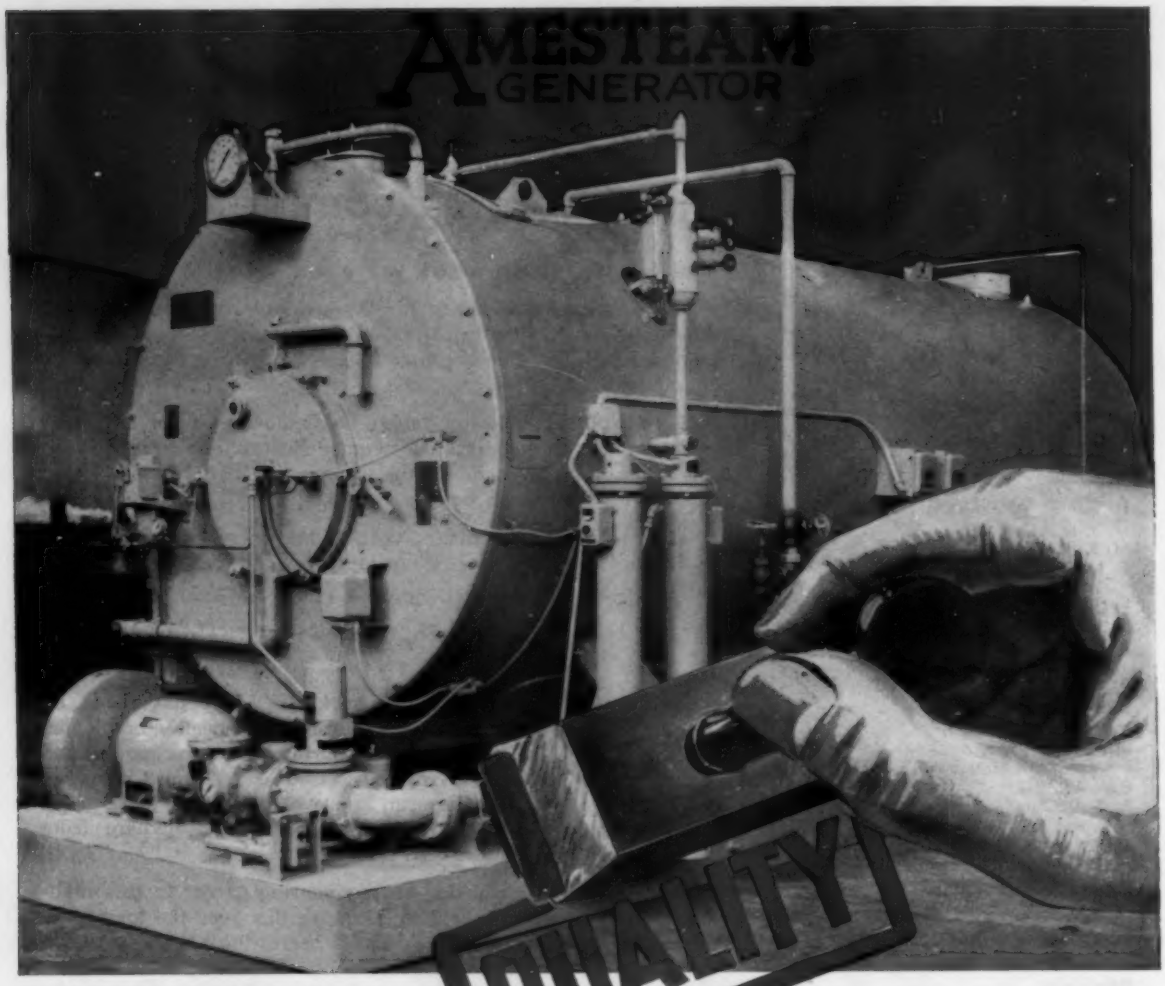
But launching or shifting an engineering career in this high-tension environment I hold to be dangerous over the long haul. Why? Because the man who parlays recruiting programs into a "deal" for himself has sold a piece of himself to the Devil. It takes several years for any engineer to be trained by his company to the point where he begins to earn every dollar he's paid. Recruiting nowadays costs anywhere from $1000 to $5000 per man signed up. He who extracts a recruiter's bounty for the job he condescends to take will be in debt to his employer that much longer.

But most important, I feel, is that recruiting tends to emphasize a "deal" in which dozens of factors *extraneous to engineering* obscure vision for what should be the basic recruiting job—namely, matching the individual to the kind of job that will develop his abilities most fully.

We know that engineers are recruited to fill a quota, hoping that the home office can use them—somehow. But when frenzied recruiting gets in the way of matching engineering talent to engineering challenge, the engineer is sold short, industry is sold short, and our civilization is sold short. Ultimately, we will find that we are not extracting maximum professional productivity from our engineering talent. Careers will be stifled because engineers are lured into jobs on every basis except their individual talents. This is waste of human resources. Let's quit *luring* engineers. Let's just *hire* them.

Harold A. Bergen

Editor



It takes a Boiler to produce LOW COST STEAM

. . . and isn't low-cost steam what you're actually after in a boiler? There's only one way to get it — with a boiler of proven high quality.

Ames Iron Works has been building such boilers for 108 years, putting into them the engineering, material and workmanship necessary to give the best possible service to the customer.

Today's AMESTEAM GENERATOR, with its simple, efficient, 3-pass design, embodies the best of those 108 years — the latest developments which we know are practical. And the number of customers ordering their 2nd, 3rd, 4th, 5th and more AMESTEAM GENERATORS justifies the painstaking care that goes into these units.

For a quality boiler that's bound to give you overall steam economy — plus the well-known AMES 24-hour service — specify AMESTEAM GENERATOR — 20 sizes, 10 to 600 h. p. 15 to 200# Oil, Gas or Oil-Gas Combination . . . *Mail coupon today.*

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Please send me further information on AMESTEAM GENERATORS and name of the nearest representative.

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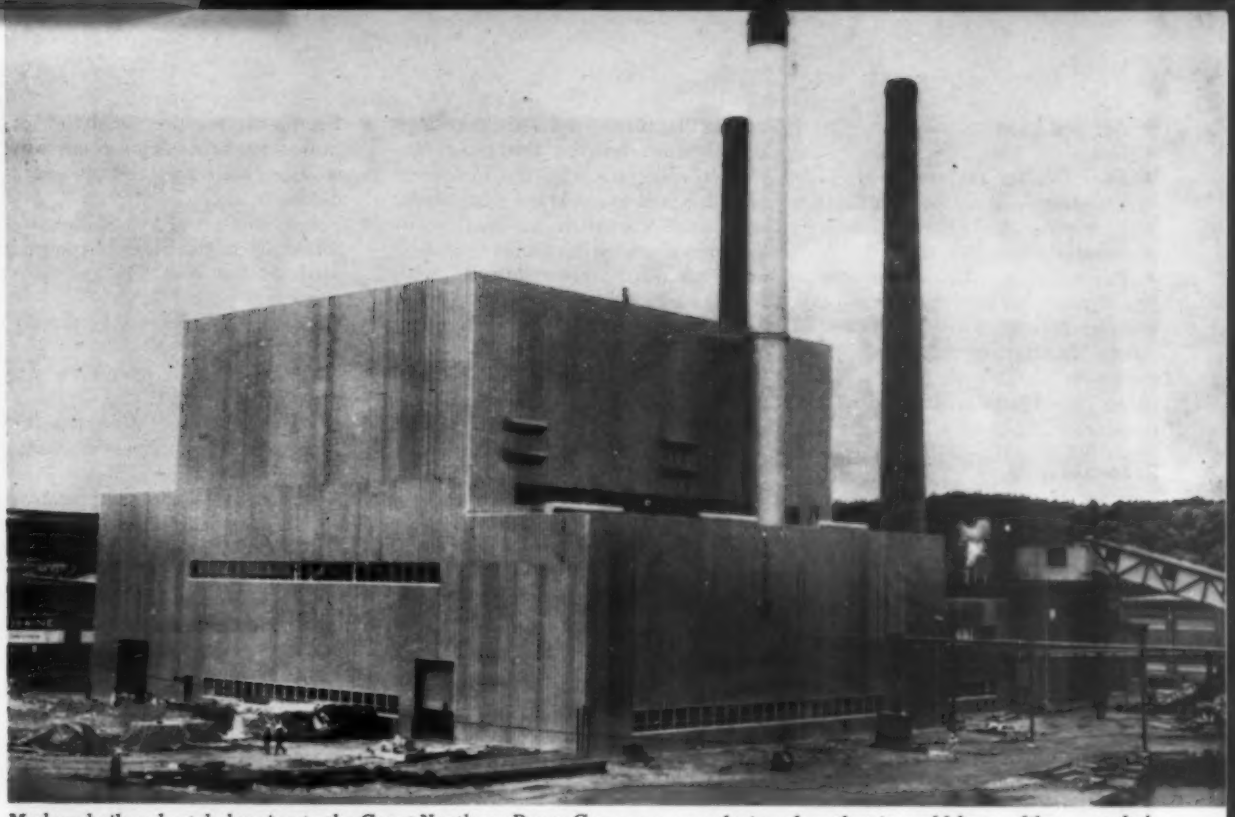


Modern boiler plant, belonging to the Great Northern Paper Company, was designed so that it could be readily expanded.

How to get MORE ECONOMY in Industrial Boiler Plants

J. M. TOTTEN
Stone & Webster Engineering Corporation

TO PRACTICE ECONOMY, we must know what our costs are, what determines them, and what we can do to control them. In this control of costs, however, we must guard against the false economy of saving money in ways that will impair plant reliability.

For every business enterprise there are two main classes of costs —fixed costs and operating costs. Fixed costs go on as long as the business exists and are not much affected by day-to-day production rates. Interest paid on bonds, insurance premiums, money put into depreciation reserves, taxes paid on real property, and administrative expenses are all fixed costs.

Operating costs are those which are more or less proportional to production volume. In an industrial boiler plant, these costs are mainly incurred for fuel, operating labor, maintenance, water, and supplies.

Cost of generating steam is profoundly influenced by plant design. Apparently, there has not been a general realization of this fact, nor that high-grade engineering skill is essential in designing steam plants that are both efficient and reliable. Design factors which the engineers must consider are numerous. Some of the most important are:

- Site
- Soil conditions
- Climatic conditions
- Water supply—quantity, quality
- Transportation facilities
- Electric power supply
- Labor situation
- Steam load — initial and future
- Number of boilers
- Type and size of boilers
- Spare boiler capacity
- Auxiliaries — whether motor or steam driven, and methods of control
- Stack
- Kind of fuel
- Fuel storage and handling
- Ash handling
- Heat balance
- Piping
- Instrumentation and control
- Structural details — indoor or outdoor
- Aesthetic considerations

- Air pollution
- Noise
- Facilities for maintenance
- Building heating and ventilation
- Fire protection
- Sanitary facilities
- Provision for plant expansion

A broad background of experience in diverse industries is needed when considering these and other pertinent factors to yield a completed plant that will be adequate, flexible, and not over complex.

Recordkeeping

Basic data for determining operating costs can only be obtained from a well organized record system which, to be of any value, must be both complete and continuous. Strict account should be kept of fuel received, fuel used, labor man-hours, water used, steam produced, electricity consumed for auxiliaries, chemicals, lubricants and miscellaneous supplies used.

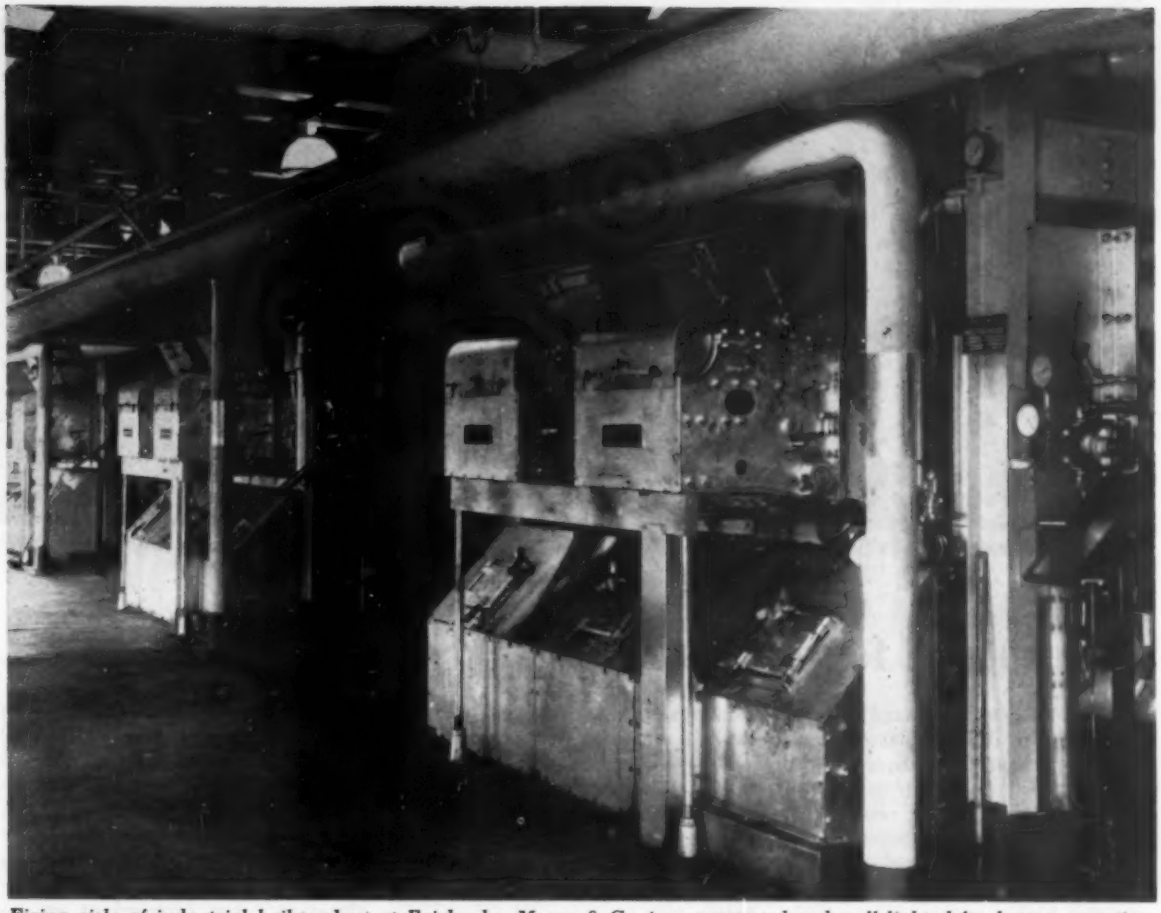
Without records, we are unable to evaluate intelligently many important factors — we are operating blindly and leaving too much to chance. For example, the question of which fuel to use is not just "shall we buy $10 coal or $9 coal?" To determine which is more economical, we must investigate the effect of fuel quality upon cost of fuel handling, storing, and grinding, cost of ash removal, air heater protection, and boiler maintenance and cleaning. Records are essential in assembling the factual data upon which to base a decision on such questions. Records imply the existence of indicating, recording, and integrating instruments as required by the installation.

Boiler efficiency reduces costs

Fuel cost is a function of boiler efficiency. Boiler efficiency may be improved in a number of ways, the most important of which are:

- Intelligent distribution of load among the available boilers without adversely affecting reliability.
- Frequent, regular analyses of flue gases to determine amount of excess air and completeness of combustion.
- Establishment of a soot blowing schedule on the basis of records of draft loss and flue gas temperature.
- Check of boiler settings for air infiltration.
- Regulation of blowdown by water analyses.
- Regulation of fuel oil temperature to secure proper viscosity for good atomization.
- Regulation of steam pressure and temperature in fuel oil heaters to avoid fouling the heating surfaces with scorched oil.
- Check of fineness of pulverized coal to detect pulverizer wear and to prevent loss from combustible material in the ash.
- Check of coal sizing so as to assure proper size range and proportions for spreader stokers.
- Finding and elimination of all steam and water leakages.

Power stations like Oak Creek point the way for industrial plant safety with wide gangways and orderly appearance.



Firing aisle of industrial boiler plant at Fairbanks, Morse & Co. is uncongested and well lighted for better operation.

- Prevention of boiler deposits by adequate water treatment.
- Prevention of corrosion in boilers and piping by water treatment, including deaeration of feedwater.
- Continuous check on purity of condensate returned from process to prevent fouling of internal boiler surfaces.
- Close inspection of boiler baffles to detect short circuiting of gases.
- Precautions to prevent coal from absorbing moisture.

To be satisfactory, a plant must not only be operated efficiently, but also safely. Safety of operators must come first, then safety of equipment. Safety of operators depends upon a combination of education and enforcement of rules and regulations. Carrying the load is important, but throughout the organization everyone must understand that his own personal safety and well being take precedence at all times. With this clearly understood, there should be no trouble with accidents resulting from individual carelessness.

Planned maintenance pays

A desirable feature in cost control is the carrying out of maintenance on a planned instead of an emergency basis. Emergency repairs carry the penalties of premium freight charges and overtime wage rates, not to mention lost production and interest charges on idle machines.

Planned maintenance definitely improves plant reliability because potential failures can be discovered in the incipient stage. Planned maintenance develops information especially useful in determining when to retire equipment. Detailed schedules under which each piece of equipment is serviced at predetermined regular intervals, permit the most efficient use of labor. Planned maintenance locks the stable door before the horse is stolen.

An important aspect of maintenance is housekeeping. Good housekeeping connotes cleanliness, neatness, and order. It is worth the effort for at least two reasons. First, if a machine breaks down, the trouble can be diagnosed and remedied faster, because it is not necessary to scrape away dirt and dig through grime. Second, the psychological effect upon operators increases their respect for a management that knows what high standards are and insists that they be met and maintained.

In maintenance, as in operation, good records are essential. In fact, a worthwhile budget for maintenance expense cannot be established without them. Records tell us where we have been and serve as guideposts to where we are going.

Another factor in controlling

costs is maintenance material. Without doubt, material of the very best quality obtainable is the least expensive because the labor cost of installation, removal, and replacement is usually the predominant factor. It is, therefore, preferable to use only factory-made replacement parts. Only dire emergencies justify the use of homemade parts.

Then, too, a well-organized stock room is essential. It should be so operated to indicate immediately what is in stock, how much, and just where to find it.

Purchasing's part

Purchasing Departments must be provided with definite specifications. As far as is practical, requisitions should be submitted sufficiently ahead of time so that the Purchasing Department can obtain exactly what is required yet avoid the extra cost of overtime labor and premium transportation charges.

Manpower and morale

Good management is inescapably concerned with details — small details. Most important details are those concerned with getting the best performance from men on the job. Is the right man doing the right job? Does every key man have an understudy? It any man assigned to a job which is beyond his physical or mental capability? Morale is influenced greatly by the attitude of management. Are operators encouraged to think for themselves? Does management keep its promises? Does management inspire operators to take pride in their work? Does management help them to develop greater skills? Is the training program adequate? Are operators taught what to do in emergencies as well as in normal operation? Are operators being led or are they being driven? Is discipline maintained without antagonizing operators? Is each man supplied with the right tools and materials? Do operators stand idle for lack of proper supervision and direction? Is management sincerely concerned with the physical and mental well-being of its employees?

Answers to these questions exert a profound effect upon costs of operation and maintenance. When answered correctly, one has the right to expect a smooth running plant, a low accident rate, and a low rate of labor turnover.

The future for industrial research

If we take a good hard look at what we are doing today, I think it is clear that in spite of all the progress that has been made, we can see that industrial research is largely carried out by what might be called "captive" organizations. Furthermore, these organizations are still highly specialized in their approach to each specific problem and compete only indirectly with one another. If I may use an analogy, I would say that we are in the stage of the automobile industry when it was making automobiles by hand. In those days the cars were of excellent quality, but very few people could afford to buy them. The industry would never have grown if it had not changed its methods.

I think the day is fast approaching when industrial research will produce technology as an industrial product in its own right. As this day approaches, industrial research will become more and more a separate industry creating an important raw material under highly competitive business conditions.

It seems to me that as time goes on a greater and greater share of our technology will be provided by independent research organizations not attached to specific industrial concerns. These independent research organizations, by competition amongst themselves, will establish the competitive market value of various forms of technology. Our present "captive" research organizations will remain in business only to the extent that they can compete with the independent groups and do an even better job.

This competition will greatly accelerate the development of improved research techniques, and by freeing our trained scientists from routine work they are now doing, will permit them to concentrate on truly creative activities. This will tremendously increase our capacity to make new discoveries and provide technical solutions to an ever broadening field of problems. Furthermore, as new tools are provided, the cost of our new technology will steadily be lowered, and find application in many areas where it is now considered too costly.

In particular I feel certain that as technological services become more and more available on the open market through the growth of independent research companies, entirely new consuming areas will be opened up. These new consuming areas will be the host of medium and small businesses in the country, which can then take advantage of the ability of efficient independent research organizations to produce the technology they need at a cost far below that of attempting it in small laboratories of their own. This in turn will create new industries and new competitive forces, and both industry and technology will continue to surge forward at an increasing tempo.

I see this growth dependent on the development of greatly improved research techniques and equipment. These new techniques will not only lower the cost of producing our expanding technology, but will have the added advantage that its growth will not be limited by potential shortages of scientific personnel.

I see a new kind of industry which produces technology as a highly competitive business activity.

I see greatly increased emphasis on the management and coordination of industrial research with independent research organizations setting competitive standards and increasing in importance as they develop new and fertile markets for technology.

. . . E. D. REEVES
Executive Vice President
Esso Research and Engineering Company.

Mechanical tube cleaning has revolutionized maintenance of vertical shell and tube type open head ammonia condensers

HALT your losses in refrigeration condensers

A. JOHN
Thomas C. Wilson, Inc.

KEEPING CONDENSERS efficient by using proper tube cleaning equipment can cut operating losses significantly. Total cost of thorough, effective mechanical tube cleaning is insignificant in comparison with the costs resulting from efficiency loss through mounting head pressures.

Table shows how an increase in head pressure, due to dirty tubes, increases cost of ice production in an ammonia compression plant.

For an ice plant producing 300 tons of ice per day, 300 days per year, the cost of power for one year would be $37,800 with a pressure head of 127 psi. An increase in head pressure to 153 psi would raise the power cost to $44,280. Loss of efficiency that could have been saved by proper tube cleaning represents a net annual loss of $7480!

Difference between this figure and the initial cost plus operating expense of proper tube cleaning equipment clearly shows why tube cleaners are so widely used in the refrigeration industry.

Mechanical tube cleaners have proved indispensable where high head pressures caused by fouled gases in the refrigeration system and dirty condenser tubes have led to excessive power, labor, and maintenance costs. Here are some reasons why:

- Mechanical tube cleaning takes only approximately ⅓ the time required for hand scraping or brushing.
- Head pressures drop immediately—even during the cleaning.
- Heat transfer rate is increased by about 35 percent.
- Efficient film temperatures are restored.
- Mud, algae, scale are completely removed.
- No shutdown is required on open shell condensers.
- Mechanical cleaning is more thorough than hand cleaning.

Mechanical tube cleaners are available using air, steam, water, or electricity—so there is a wide choice of power sources. This can be important because condensers in many plants are in remote locations. Cleaners are available in every size with many different types of cutter and motor arrangements. Their use in refrigeration equipment maintenance assures rapid increase in efficiency, simple maintenance, and long equipment life span.

COST OF HEAD PRESSURE INCREASE

Ammonia head pressure	127 psi	139 psi	153 psi	168 psi
Tons of ice per day per ton refrigeration[1]	.75	.75	.75	.75
Power cost per ton ice produced[2]	$0.420	$0.453	$0.492	$0.525
Percent increase in costs	0	8.0	17.2	25.0

[1] 8 percent system loss is assumed
[2] Based on $0.015 per kwh power cost

Better intake means *better* ventilation

D. D. HERRMAN
Chief Engineer
Hartzell Propeller Fan Co.

SUCCESS OR FAILURE of your plant's ventilating equipment may depend on your intake-air system. Exhaust systems for removing heat, smoke, and fumes from an industrial building tend to create negative pressure within the building. Exhausted volume of air must, in some way, be replaced by an equal volume of outside air.

Air replacement is not a serious problem during summer months when windows and doors are normally left open. Ventilating fans may be operated to bring in additional fresh outside air. During cold weather, however, when buildings are kept tightly closed, negative pressures are often not corrected by natural intake. One or more of the following conditions may exist:

- Exhaust system capacity is reduced below point required to accomplish purpose for which it was installed.
- Efficient combustion in oil-, gas-, or coal-fired equipment is seriously hindered.
- Stack gases are pulled back into building by exhaust fans.
- Doors are hard to open.
- Cold air pulled in when doors are opened, and cold air leakage around windows and through cracks causes considerable discomfort among workers.

Two primary factors — temperature and air placement — must be considered when planning any remedy for these or similar problems.

Louvered opening are, of course, the simplest solution. Exhaust fans then will draw air inside the building as they create negative pressures. This solution allows no control over either temperature or placement of the intake air.

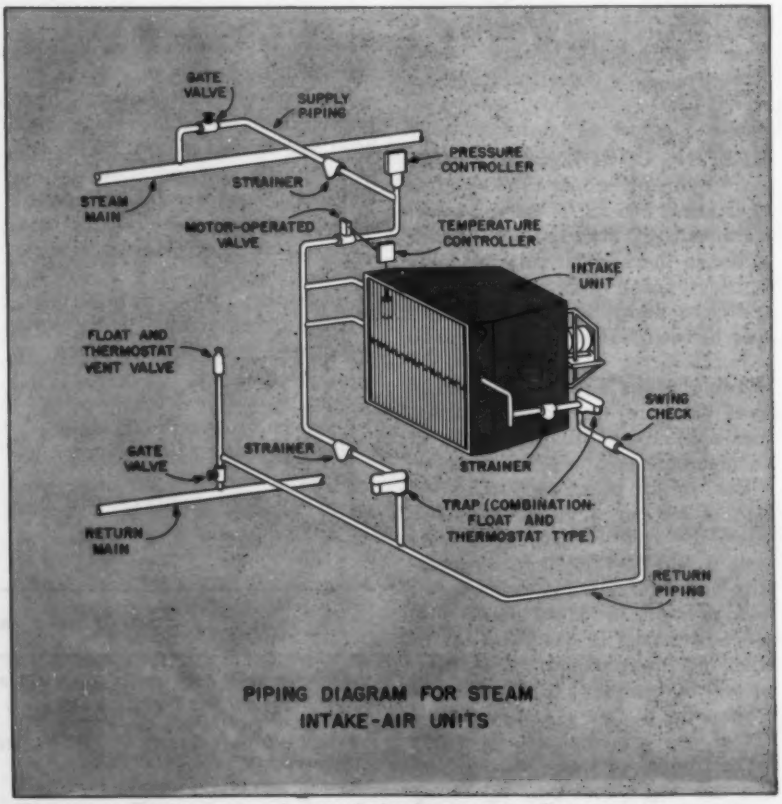
Second solution—duct installations with an intake fan — allows controlled placement of intake air. It does not, however, provide for any temperature control. Such systems are most satisfactory when the air can be carried directly to a major heat source.

In many cases, however, unheated outside air may seriously threaten the comfort and health of workers in the area. Unheated air, in other installations causes serious fogging conditions within the building. In these cases, makeup air must be heated before it is released.

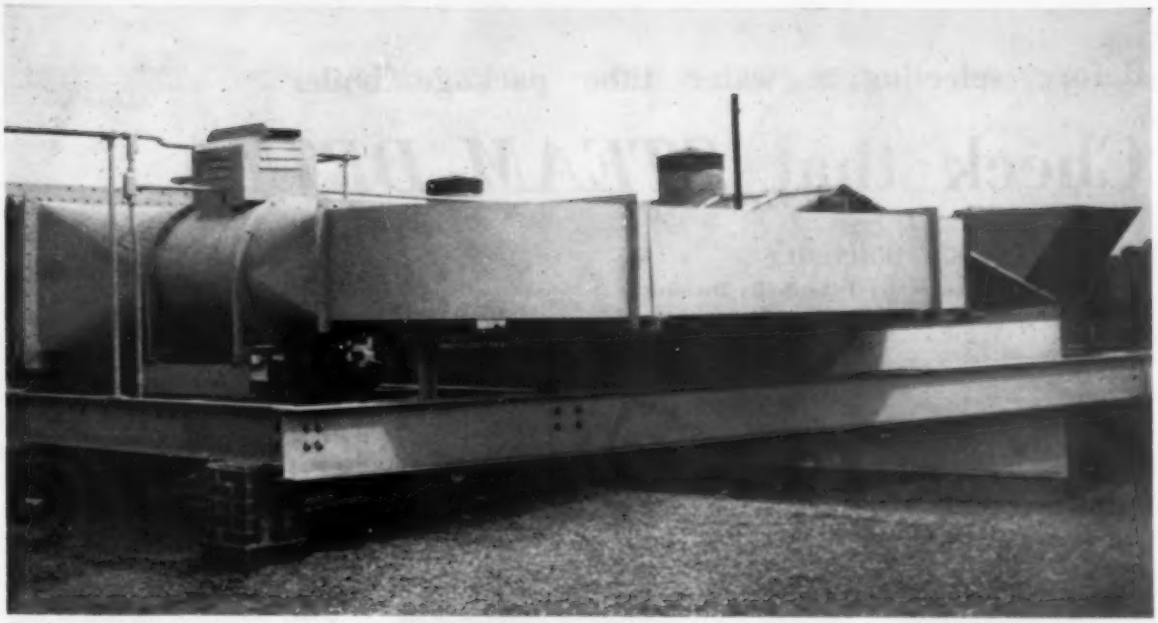
In some instances, heated air can be satisfactorily supplied by installing heating coils in the louvered openings. Low static pressure created by the exhaust system will draw in makeup air as required.

Keep in mind when calculating fan performance that static pressure drop through the coils must be added to the exhaust system static pressure. In most cases, consequently, the original exhaust system fans will have to be replaced by fans of greater capacity if intake-air heating coils are added after engineering the exhaust system.

Makeup air can be supplied by installing one or more intake units. Each unit should include components for moving and heating the



Typical piping diagram and controls for heating-ventilating unit using steam. Unit may be mounted to heat and circulate either inside air or incoming air.



Roof-mounted duct system provides heated, filtered air to supply process area in modern plant requiring dust-free-air.

air — with controls for regulating intake-air temperature. Filters may be incorporated where required.

Intake systems of this sort may or may not require air distribution ducts. Size of the area and nature of operation are determining factors. In paint spray booths, it is usually sufficient to supply the necessary intake air without ducts. This makeup air then works through the room and will not raise dust or disturb spraying operations.

A propeller-type fan, vaneaxial blower, or centrifugal blower may be the air-moving component of the intake or makeup air system. A propeller fan is generally most efficient and economical. A vaneaxial blower may be required where long duct runs build up higher static pressures. A centrifugal blower should be considered where extremely low noise level is an important factor.

Heat may be provided by a direct-fired heat exchanger burning either gas or oil, or by a set of steam coils. Gas- or oil-fired heat exchangers should be provided with modulating burner controls, pilot safety control, high-limit stack control, fail-safe main burner control and air outlet thermostat. Such units are also available with a two-stage, high-low flame combustion system. This system is generally unsatisfactory for anything but rough temperature control.

In buildings where existing steam supplies are adequate to accommodate additional load, steam coils will be the most economical by far. Considerable amount of steam is required to operate an intake system. For example, approximately 2 boiler hp per 1000 cfm is required where outside air at O F must be raised to 70 F.

How to calculate heat required

Heat requirements for any temperature rise may be calculated by use of the following formulas:

$$\text{Btu/hr} = (\text{cfm})\ (\text{Temperature Rise [F]})\ (1.085)$$

$$\text{Boiler hp} = \frac{\text{Btu/hr}}{33{,}520}$$

Where existing steam supply is not adequate, relative cost of providing additional steam or utilizing an oil- or gas-fired system will vary widely. Steam is, however, and has been, the most widely used heat source. Complete intake units with steam coils are the most readily available. When a steam system is used, savings on intake equipment and installation may offset any difference in the cost of supplying heat from oil or gas.

Intake units may also be used as supplemental heating equipment. This is accomplished by installing a face and bypass damper system. Outside air can then be shut off and inside air recirculated through the heating coils. This application can be particularly helpful in buildings where some heat source is needed to raise the temperature to a comfortable level at the beginning of the day. Process equipment may supply adequate heat once in operation.

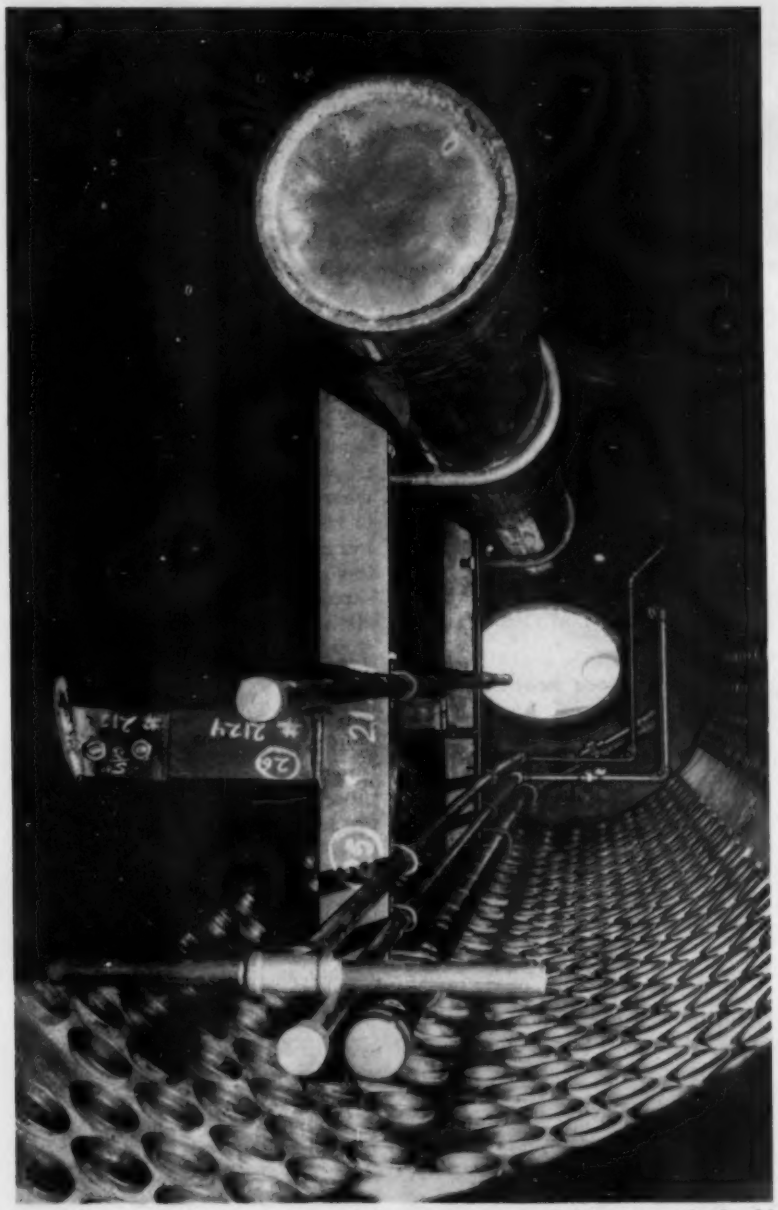
Engineered intake air systems — using either ambient or heated air — are not a new development. Several factors, however, are contributing heavily to an accelerated interest in such systems. Among these factors are increasing use of engineered exhaust systems, increasing proportion of newer industrial buildings without sufficient makeup air entering through incidental openings, and increasing concern about worker comfort and morale as they influence production schedules.

We may never see the time when every industrial exhaust system is paired with a companion intake air system. But the time is rapidly approaching when intake air supply will be a definite consideration in planning any exhaust system. Where an intake unit is not specified, it will be a conscious rather than an unconscious exclusion.

Before selecting a water tube package boiler

Check that *STEAM DRUM*

FRANK F. HOHNHOLT
Manager, Water Tube Boiler Division
Superior Combustion Industries, Inc.



Steam drums should have two manholes for easy accessibility. Internals should be removable and as few as possible so as to reduce outage time to minimum.

NO STEAM GENERATOR, packaged or otherwise, is any better than the poorest component of the assembled unit. A very important component of any boiler is the steam drum, particularly in package boilers. Safety is no worry. Boiler steam drums are pressure vessels and are subject to the Boiler Code. Materials, method of calculating stresses, efficiency of ligaments, and safety factors are all set down. Welders must be qualified, so the grade of workmanship is also established. All this is done for public safety.

It doesn't matter, then, who sup-

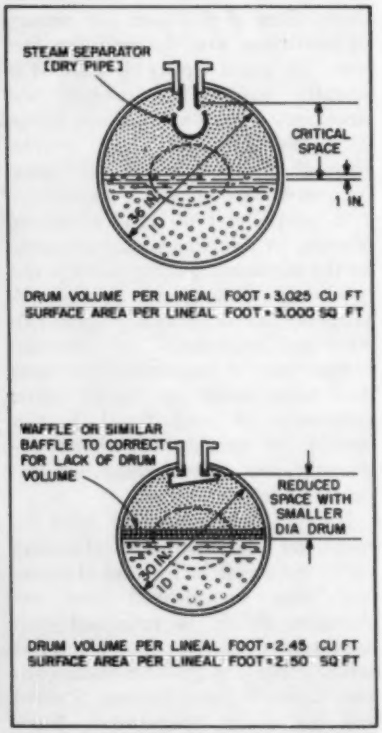

STEAM SEPARATOR (DRY PIPE)
CRITICAL SPACE
1 IN.
36 IN. ID
DRUM VOLUME PER LINEAL FOOT = 3.025 CU FT
SURFACE AREA PER LINEAL FOOT = 3.000 SQ FT
WAFFLE OR SIMILAR BAFFLE TO CORRECT FOR LACK OF DRUM VOLUME
REDUCED SPACE WITH SMALLER DIA DRUM
30 IN. ID
DRUM VOLUME PER LINEAL FOOT = 2.45 CU FT
SURFACE AREA PER LINEAL FOOT = 2.50 SQ FT

Fig. 1—Small steam drums need complicated internals to give dry steam.

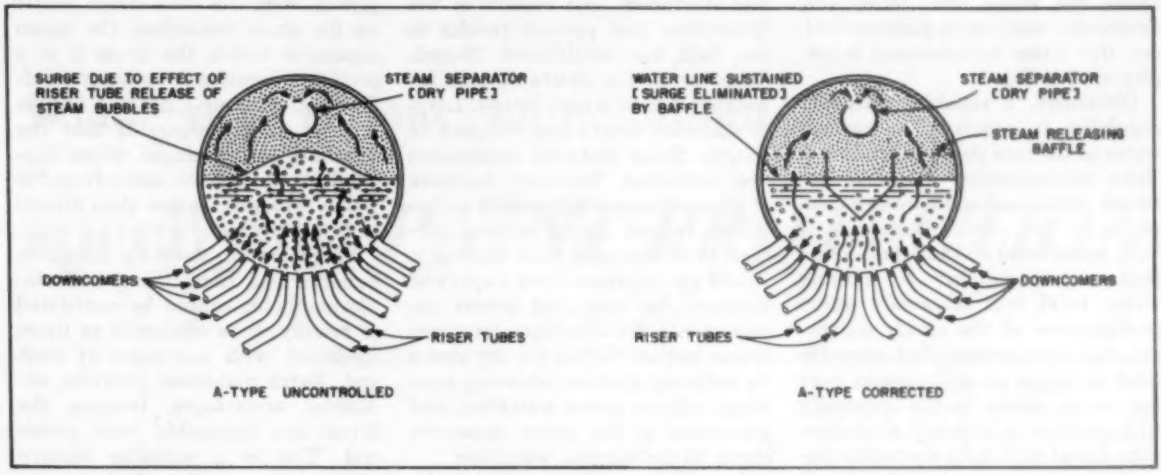


Fig. 2 — Drum of A-type package boiler, showing how baffle is used to eliminate surge from risers releasing steam.

plies a boiler — the pressure parts are safe units if they comply with code requirements. A safe steam drum differs from a well-designed steam drum in drum size, arrangement, and type of internals within the drum, and placement or location of the drum nozzles. Other differences include number and size of manhole openings, and details which make for the production of dry steam, steady water level, and accessibility within the drum for making repairs in minimum time.

Sizing of drum is important

Too often, a steam drum is referred to as a small or large unit by indicating diameter only. The only true method of sizing a steam drum, however, is by length and diameter. Since package boilers have longitudinal drums, and since increased capacity is obtained by increasing boiler length, it follows that steam drums for package boilers are long. Having established one dimension of the steam drum, how now shall we determine its diameter?

Established steam quality for boilers operating under saturation conditions (no superheat) and for pressures as provided by package units, is 0.5 percent moisture, or steam quality of 99.5 percent. To obtain this quality over a wide range of operation (including reasonable peak steam production), it is necessary to provide either elaborate drum internals or simple internals with large surface-releasing areas and large drum volume

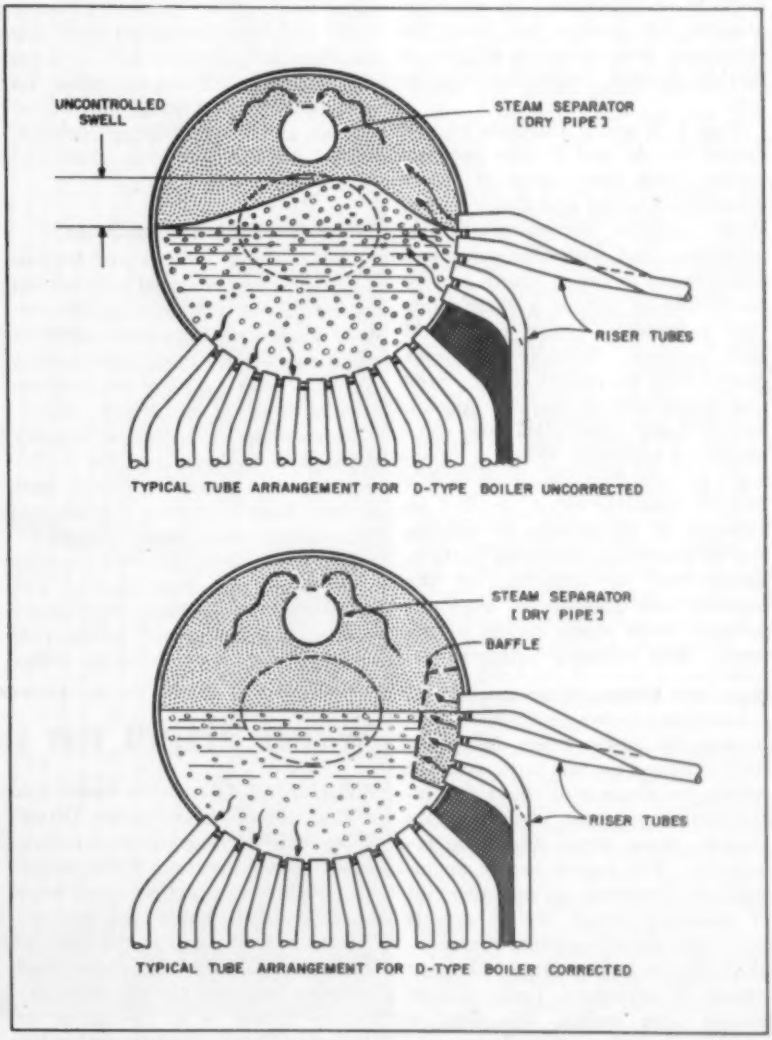


Fig. 3 — In D-type package boilers, surge is eliminated by locating a baffle around riser tube inlets. If drum is small, elaborate internals may be needed.

above the water line. Since long drums are common to package boilers, this latter arrangement is employed. See Fig. 1.

Obviously, a reliable feedwater regulator is required to replace water at the rate steam is produced. Tube arrangement, divided between riser and downcomer elements in the steam drum, affects both water level and function of the feedwater regulator. A surging water level will adversely affect performance of the steam separator. An arrangement that provides riser elements equally spaced over the entire drum length generally will produce a steadier waterline than a unit with riser elements concentrated in one area of the drum. Space between water level and steam separator is an important element to be considered. In some instances this feature has been the difference between using single-, or double-element feedwater regulators.

Figs. 1, 2, and 3 illustrate typical drums for A- and D-type package boilers with tube nests of risers (steam releasing) and downcomers. With suitable corrective baffles, when required, waterline surge and disturbance in drum length can be controlled to permit a simple dry pipe to produce steam quality of 99.5 percent. Smaller diameter drums with decreased surface area and drum volume require special, and in many cases elaborate, compensating internals. When comparing a 36-inch diameter drum with a 30-inch diameter drum, we find an increase of 23 percent in volume and 20 percent in releasing surface. Elimination, or reduction of the number and quantity of internals permits more ready access to the drum, thus reducing outage time.

How are internals arranged?

Looking beyond the function performed by steam drum internals, their arrangement and support within the drum will affect the determination of drum diameter. Obviously, these items should be removable. For minor repair or inspection, however, an arrangement of internals which would permit entry into the drum without removal of any or only a single element would be preferred. Reduction of outage time makes this feature worthy of serious consideration.

Experience from many boiler manufacturers' test results in the laboratory and proven results in the field has established 36-inch diameter as the desirable size for package boiler steam drums. Larger diameter drums may be used, of course. Since shipping dimensions are restricted, however, increase of drum diameter beyond 36 inches would reduce boiler heating surface. With the same tube spacing, it would also increase draft losses and increase fan size and power requirements. Smaller diameter steam drums reduce factors for dry steam by reducing surface releasing area, drum volume above waterline, and placement of the steam separator closer to the surging waterline.

Specifications for water tube package boilers are often written with the statement that "no drum shall be less than [a given] diameter." It is recommended that this practice be discontinued in favor of actually specifying the minimum size of both the water and steam drums, and also indicating the minimum surface releasing area and steam drum volume.

What is effect of expansion?

All package boilers are bottom supported and enclosed with a steel casing. These two facts make vertical movement impossible without rupture of steel casing or welded joints. Vertical expansion is taken care of by bends in the boiler tubes.

Horizontal expansion is equally divided at both ends of the boiler because the assembled tube nest is free-floating within the casing. This affects main steam nozzle location. Obviously, the best location is at the exact centerline of the drum. In this position, there is no vertical or horizontal movement, which eliminates stresses in steam piping. With the main steam nozzle on the drum centerline, the steam separator within the drum is in a preferred location for maximum efficiency. Although not too important, it is recommended that the auxiliary steam nozzle, when supplied, should take its steam from the steam separator rather than directly from the drum.

Manholes are used for access to boiler drums. Long drums with single manholes cannot be ventilated as readily or as efficiently as those equipped with manholes at each end. Extra manholes provides additional advantages, because the drums are accessible from either end. This is a valuable feature when an examination of a hot drum must be made. Considerable time is saved in waiting for the boiler to cool off. Often, a tube plug can be installed without entering the drum, which might be impossible if only one manhole were provided. With proper ventilation, maintenance men can remain within the drum for longer periods and so reduce cleaning and repair time. Manhole covers should be hinged so that they can swing into the drum without being handled.

Drum internals, with one exception, can be fabricated of carbon steel. Chemical feed pipes should be made of an alloy steel material such as stainless steel because of the corrosive chemicals employed for boiler water treatment and temperatures involved.

Before you buy your package boiler, be sure that it will do the job you require with some margin for abnormal loads. Remember that no chain is stronger than its weakest link, and to make dry steam, you must have a properly designed, efficient steam drum.

Wind effect on tall stacks

TALL STACKS vibrate under the action of steady winds. Direction of this vibratory motion is normal to wind direction. Stack structure under wind action constitutes a self-excited vibrational system. Vibration frequency is the natural frequency of the structure and remains constant for all wind velocities. Stack is at resonance at all times. There is no critical wind velocity in the sense of forced vibrational response. Amplitudes increase with higher wind velocities.

In conventional stack arrangements, steam generators, when present underneath the stack, appear to serve as vibration absorbers, thereby contributing substantially to the overall damping capacity.

. . . M. S. Ozker and J. O. Smith, ASME Annual Meeting, 1955

What you should know about specifying *PAINT PROTECTION*

T. J. EBERHARDT
Subox, Inc.

Flow coating paint is simple method of completely covering complicated equipment or irregular surfaces. Drips are recycled until coverage is complete.

BECAUSE LABOR is the chief contributor in painting costs, selecting the right painting material becomes necessarily important from the point of view of preventing too frequent repainting.

Paint materials costs are relatively unimportant. Even the most expensive paint makes up only a small fraction of the total cost of the steel itself or of the painting costs. So paint prices should be judged only by the service performed and not by competitive prices.

Proper surface preparation and proper paint application are prime requisites for good results. These processes are constantly being simplified to keep costs to a minimum. For example, permitting an oil storage tank to rust for a year prior to painting will permit the majority of millscale to pop off, eliminating pickling and sandblasting costs. If galvanized surfaces are allowed to weather for a year or longer, acid pretreatment may be eliminated from surface preparation specifications. Paint application has also been simplified by the use of sprays, roller-coating equipment, and flow-coating procedures, all of which cut down labor expenses.

In paints themselves, great strides have been made to shorten drying times and to increase chemical resistance and durability. Some systems permit the application of two or more coats in the same day to build up essential film thickness. Other paints are formulated to do the job in one or two coats where previously three or more coats might have been required.

When preparing painting specifications for new plant construction, all these items should be carefully considered. Paint systems must be made to fit in with the construc-

tion schedule. Application will have to be made under conditions that may have their own peculiarities. No one set or type of specification can be used for all jobs. Each must be considered on its own merit.

Generally, facilities for pickling, sandblasting, or other elaborate surface preparation of steel are not available on the construction site. Time required for such processes may not be available if schedules are to be met.

Shop coat should be good

Most steel is delivered on the job with a shop-applied coat, however. It is assumed that the steel fabricator has been rigorous in following specifications for thorough cleaning and drying of the steel prior to application of this shop coat, and that the prime coat has been applied with reasonable care and diligence.

Shop coats provide adequate protection for steel while in transit and erection, but they are subject to abrasion and damage through handling. Such film ruptures permit minor rusting. These spots should be cleaned and repaired prior to further painting. If these repairs are made with reasonable promptness, no great cleaning or painting costs or time delays should be encountered. Then the job is ready for field coats. Number of coats required is kept to a minimum in an effort to speed completion of the project and to get it into productive service.

When selecting paints, the vehicle (liquid portion) should be considered separately from the pigment or solids portion. Old reliable oil-type primers such as red lead-in-oil have advantages of maximum wetting and penetrating properties. They creep into voids and pits, and fill the surface pores. When rust is present, this wetting action of the oil-type vehicle is most important. These oil primers are comparatively soft, however. They are slow drying and easily affected by industrial fumes, vapors, and high moisture concentrations. If pigmented with soft pigments such as red lead, they lack good weather durability and should be covered reasonably soon after application.

New synthetic vehicles—such as alkyd resins, phenolics, and so on—dry much harder and faster. They provide much more chemical and weather resistance even though the same soft-type pigment may be used with them.

Synthetics in general, however, do not possess the wetting characteristics of oils, and surfaces should be cleaner and freer of rust or other contaminations. In painting angular shapes, workmen must be much more careful to cover sharp edges because of this lack of natural wetting. Sometimes, an extra coat may be required to make up for this deficiency. But if surfaces are properly prepared, added advantages of hardness, chemical resistance, and durability will be realized.

To prevent alligatoring, cracking, film separation or other such failures, subsequent coats of paint should be compatible with initial coats. It is advisable not to use a synthetic such as vinyl-resin paint over an oil-type primer. Always build up film thickness with similar vehicles. Many paint failures result from an attempt to take advantage of a penetrating oil-type primer followed by a much harder synthetic-type finish.

Pigments must be similar

When considering the pigment portion of paint, the same compatibility is important if future maintenance costs are to be kept to a minimum. For rust inhibitive service (which is demanded of the prime or first coat on ferrous surfaces), red lead is probably the oldest and best known of all pigments. Lead chromate and lead suboxide are similar in character and usefulness, but each possesses individual properties that are considered improvements. Iron oxide and zinc chromates, used either alone or in combination with each other or these lead pigments, also have characteristics that make them especially suitable for particular uses. Not all of these pigments can be mixed with all types of vehicles. Their uses for paint formulation, therefore, may be limited. Then, too, pigment gives paint its color and hiding power. If color is of prime importance, it may greatly influence selection of the pigment.

Where possible, manufacturers prefer to use lead pigments in as great a proportion as possible. Lead primers give excellent rust protection when used as the base or prime coat. When properly formulated, lead gives excellent service in finish coats. Where the same type of pigment can be used in all coats, a uniform and harmonious paint film is established. As this film becomes thin through wear and weathering, a single additional coat for maintenance often is sufficient to build up the old coats to their original film thickness. This eliminates scraping, sanding, and repriming prior to repainting. Lead suboxide pigments are hardest of their group, and offer good weather durability. They are therefore favored for finish coat painting either over a lead suboxide or any other type primer. When used as major pigmentation in all coats, their higher cost is offset by greatly simplified maintenance schedules.

Great wealth of raw materials at the command of paint manufacturers permit formulation to minimize the number of coats required in new construction. Often enough, a single field coat applied over the repaired shop-primer will give adequate protection and decoration at a total cost that will still keep steel construction costs much below competitive alloys or substitutes. By minimizing the required number of coats, construction and productive operation is speeded.

Alloys may be cheaper

Where costs of protecting iron and steel surfaces with paint exceed 50¢/sq ft, the paint and steel industries must squarely face the fact that it might be cheaper and better to use metal alloys, aluminum, galvanized iron, or the new aluminum-clad steels instead. Considerable research and development work is being done right now on this subject.

Steel and structural shapes are used in construction to provide strong, durable, and quickly available means of support and usefulness. They are comparatively easy to work with, readily understood through a long history, and generally preferred for economy and reliability. Steel surfaces, however, must be protected by paint. And painting means additional material costs, handling and application costs, and equally important—*time*.

How to get *Chimney Action* to work for you

WILLIAM H. PUGSLEY
Vice President
The Hays Corporation

CHIMNEY ACTION—simple as it is—is often overlooked though its importance to combustion is ever present. In a furnace, in passes of a boiler, or in a chimney—the effect is simply caused by the well-known fact that hot gases tend to rise. This tendency is due to the fact that gases become less dense as they are heated and, thus, are lighter in weight than the cooler adjacent gases. The greater the difference between temperature of heated gases and temperature of outside atmosphere, the greater the chimney action or draft. Draft is a static force—a negative pressure less than atmospheric pressure.

Natural draft is defined as the draft at the chimney base and is determined by chimney height and by the difference between the average temperature of chimney gases and the temperature of outside air. In fact, draft is directly proportional to the difference in the densities of the heated gases and outside air. Draft created per foot of vertical height due to the difference between temperature of heated gases and outside air at 62 and 100 F is listed in Table I.

TABLE I
CHIMNEY ACTION CONSTANTS

Temperature of Heated Gases F	Inches of Water Drop per foot of Vertical Height With Outside Temperatures 62F	100F
62	.00000	
100	.00098	.00000
500	.00667	.00569
600	.00742	.00644
700	.00804	.00706
800	.00856	.00758
900	.00900	.00802
1000	.00939	.00841
1100	.00973	.00875
1200	.01002	.00904
1300	.01028	.00930
1400	.01051	.00953
1500	.01072	.00974
1600	.01091	.00993
1700	.01108	.01010
1800	.01124	.01026
1900	.01138	.01040
2000	.01152	.01054
2100	.01164	.01066
2200	.01175	.01077
2300	.01185	.01087
2400	.01195	.01097
2500	.01204	.01106

Why control boiler draft?

It is generally desirable to operate a steam generating unit (which is not pressurized) under the lowest possible draft conditions, for the following reasons:

- With a low and constant draft in the combustion chamber, air infiltration through any leaks in the setting will be at a minimum —because the draft differential across any portion of the walls from furnace to breeching will be the lowest possible for any given load on the unit.
- Frequently, the steam generating capacity of the unit is limited by the available breeching draft. Available breeching draft obviously is used to best advantage when it causes the largest gas volume possible to flow rather than when it is used to maintain high furnace draft.

It is also essential to maintain a draft in both the combustion chamber and the steam generator passes to prevent the occurrence of positive pressure. Such a pressure is undesirable if the unit is not designed for pressure operation.

To be sure of maintaining a draft condition at all points, it is essential to maintain less than zero pressure or a few hundredths inches of water draft at the *highest* point in the combustion chamber. A draft maintained at this point will assure that a draft condition exists at all other points in the entire boiler.

Assume that .05 in. H_2O draft is maintained at the top of the furnace, that it is 20 feet from the furnace floor to the draft connection in the roof, that the average gas temperature in the combustion chamber is 2000 F, and that the outdoor temperature is 62 F. We find, (Table I), that a draft of 0.01152 in. H_2O is created (on the average) for each foot of vertical height in the furnace. Thus with a vertical height of 20 feet, a draft of 0.2304 in. H_2O is created. Added to this is the .05 in. H_2O draft roof. This results in 0.2804 in. H_2O draft at the combustion chamber floor. Naturally, the draft at the furnace floor will vary with gas temperature in the combustion chamber if the draft is held constant at the roof.

Draft difference causes gas flow

To cause gas flow through the boiler passes, a higher draft must be created at the boiler outlet than exists in the combustion chamber. This draft difference varies almost proportionately as the square of the gas flow and directly as the rate of steam generation. Although the boiler passes do not approach a perfect orifice, a very good determination of air flow can be obtained by measurement of draft loss. Chimney action enters this problem and distorts the square

root relationship of draft loss to air flow unless compensation for its effect is made in the measurement.

If the flow of combustion gases ceased, and the instantaneous temperature of the gases were maintained, gas flow, would no longer follow the normal flow, theoretically. Gases would tend to rise in both the combustion chamber and in the third pass, reinforcing the normal direction of flow. They would, however, also tend to rise in the second pass in opposition to the normal direction of flow in this pass.

This condition is due to chimney action and is approached as load on the boiler is decreased. That is, the draft loss due to gas flow decreases, while the chimney action remains more nearly constant and, becomes more predominant.

Under such a condition, it becomes obvious that a pressure would be created at the top of the furnace and the second pass. Such a pressure is particularly noticeable on Sterling-type boilers as well as on other boiler types when the draft is held constant at a low point (overfire) in the furnace.

How chimney action affects draft

Chimney action in the second pass is *added* to the draft loss due to gas flow through that pass, while chimney action in the third pass is *deducted* from the draft loss due to gas flow through that pass. In air flow measurement, chimney action can be nullified by correct location of the draft loss connections.

Chimney action also takes place in vertical draft connections. When measuring draft in boiler furnaces, no special precaution is required for installation of draft connections to compensate for the effect of chimney action. Precautions are necessary because the gas temperature in the connecting piping will not exceed 100 to 150 F. Thus, in a 20-foot vertical connection, chimney action will not exceed .02 in. H_2O and will not vary more than .002 in. H_2O. Such variations are of little or no importance in boiler operation.

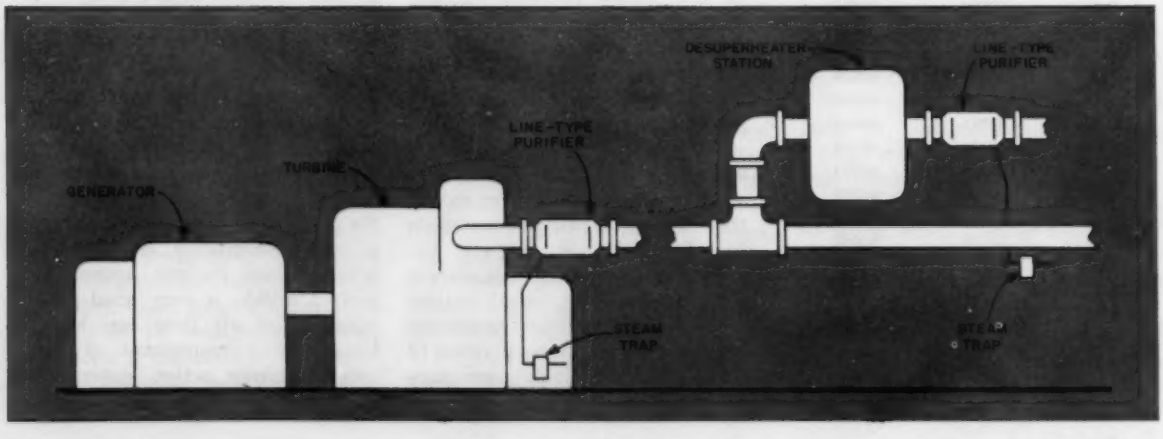
When either measuring or controlling draft, it is essential to maintain draft at a constant value within $\pm$ .005 in. H_2O and, in some applications, much closer. In all such applications, compensation for chimney action must be provided. This is accomplished by using either a differential diaphragm measuring element in the gage or controller, or a static pressure unit in an airtight case. Draft lines are usually large (frequently 2-inch pipe) to reduce friction losses in the piping. Piping is installed for both the draft and atmospheric connections.

Texas plant uses line purifiers to

Protect Steam Turbine and Deliver Dry Steam to Process

HOW WOULD YOU protect your steam turbine and process equipment from damage caused by entrainments in the steam supply? These entrainments (consisting of line scale, mineral salts, rust, and condensate) not only would shorten your equipment life but would also increase equipment maintenance costs and possibly add hours of downtime to the operations.

One Texas plant installed three line-type, multi-stage centrifugal purifiers. One high-pressure purifier is located ahead of the steam turbine for its specific protection. Two low-pressure purifiers are located immediately after the plant's two desuperheater stations to assure distribution of clean, dry steam throughout the plant.



TUNING up a power plant for better PERFORMANCE

JOHN M. DRABELLE, M.E. E.E.
Registered Professional Engineer

NEW GENERATING facilities, like any other mechanical assembly, always need tuning up. This means a critical examination for minor errors in engineering and construction. Errors in piping and connections, for instance, can have a very definite bearing on the overall net heat rate of a new unit.

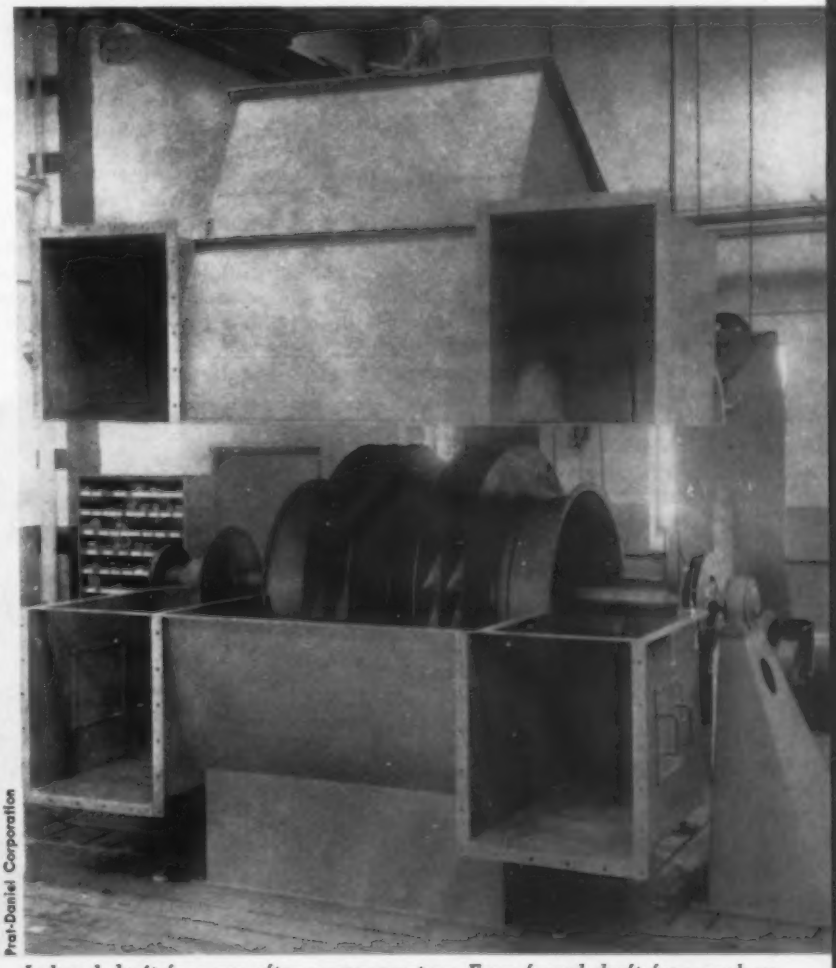
When undertaking such work, all preconceived notions and opinions must be parked at the power plant doorway. Nothing can be taken for granted. Reputations of the designers and builders must not be allowed to influence one's judgement. Everything is worth looking into, and critically, to obtain the very lowest possible overall heat rate.

Most important factor in this betterment work is that good will, cooperation, and understanding should exist between operators and engineers.

Things that have been found worthy of critical examination by practical and hard experience are:

- All extraction heaters (including the vent and drain piping) and their arrangement in the heat cycle.
- Feedwater makeup and treatment system, and the operating values maintained throughout this equipment.
- Fuel-firing equipment and combustion control system with particular reference to flame rotation of adjacent burners, temperature and pressure of combustion air. This will include temperature and pressure at burners for liquid fuel systems. Burners are designed for a certain viscosity, so fuel oil temperature must be kept just right. With natural gas firing, pressure at the burners must be checked.
- Plant service or auxiliary power used in connection with the new generating facility. This includes boiler feed pump, induced draft fan, forced draft fan, miscellaneous service pumps, and illumination.

A preliminary step of great value is to plot on one sheet of graph paper, the maximum and minimum load carried daily for a past period of not less than 90 days. On another sheet of graph paper, plot the daily gross and net generation in kwh and also the daily light and power consumption for the same period of operation. Record the amount of



Pratt-Daniel Corporation

Induced draft fans are often power wasters. Even forced draft fans, such as this one, can lower boiler efficiency if excess air volume is delivered.

power used by the respective auxiliaries for three general conditions—half load, full load, and at capacity.

Testing equipment needed for this work is relatively simple. To check the amount of power being used by various motors, a clamp-on type combination ammeter-volt-watt meter is convenient. An assortment of top-quality pressure gages is necessary for determining the pressures developed in the boiler feedwater pumping system and its relation to the boiler drum, superheater outlet, and turbine throttle pressures.

It is of the utmost importance that these gages be calibrated for the approximate operating pressure for which they are to be used. To do this, a dead weight gage tester is an absolute necessity.

Textbooks that will be useful because they show many pieces of apparatus that will be involved in the checks of equipment include:
Steam Power Stations by Gaffert,
Power Plant Engineering by Morse,
Water Treatment Systems by S. T. Powell,
Combustion Engineering by Otto de Loranzi, and
Steam Turbines and their Cycles by J. K. Salisbury.

Plant service power

Design of modern power plants has replaced the hopelessly complex steam-driven auxiliary power supply that was found 30 years ago by electrically driven auxiliaries. Steam-driven auxiliary power units with their accompanying high-pressure steam and exhaust piping, had no heat balance at all, except at possibly one point. They caused many operating and maintenance problems.

Early in the development of modern diesel trains, the railroad people developed a terminology that the power generation industry could well make use of—"Parasite Power." Amount of power used on these high-speed trains for air conditioning and lighting was, of course, far in excess of that used on their predecessors. Consequently, every kilowatt of energy used for air conditioning and lighting was regarded as parasitical. They took power from the supply, leaving less power for traction. Auxiliary power in a power plant is similar. It is a parasite and should be reduced to the absolute minimum.

Modern ease of obtaining electric measurements helps to give a prompt solution to the question of where excess power is going. Looking at a modern power plant in perspective, the auxiliaries present a clear picture.

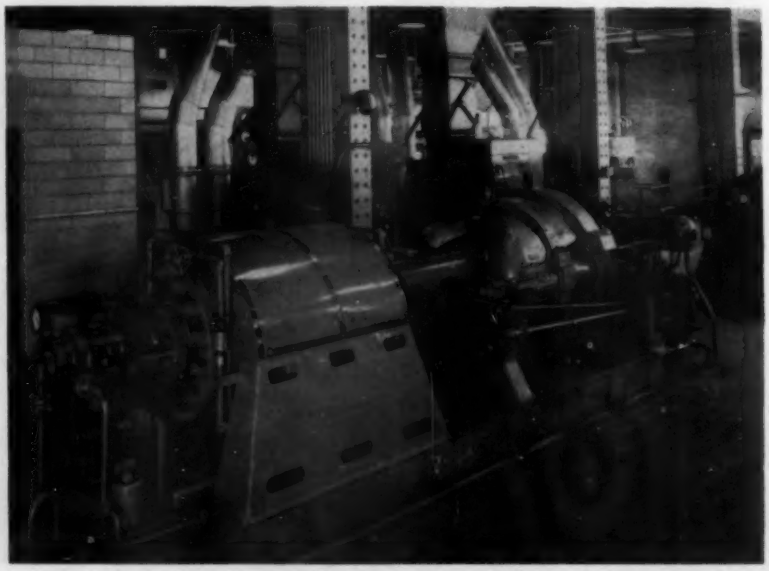
Feed pump uses most power

Largest single power consuming auxiliary is obviously the boiler feed pump. Other big offenders are induced draft fans, condenser circulating water pumps, and forced draft fans. Miscellaneous service pump requirements, such as house service, together with air compressors and lighting, make up the rest of the parasite power losses.

At the design stage of the plant, certain assumptions have to be made regarding the requirements, quantity, and pressure for boiler feedwater pumping. Safety factors and tolerances necessarily creep into the calculations. But once the unit is in service, measurements of suction pressure and discharge pressure at the pump, drum pressure, pressure drop across boiler feed regulating valves, pressure at superheater outlet, and pressure at turbine throttle flange all become measurable realities. Operation of the turbine at forced capability will, of course, give the demand on the boiler in steam output. By forcing the boiler to its limit, it will be found that it can give a certain output without much drop in efficiency, and this represents kilowatts at the turbine shaft. So the number of gallons per minute that are required from the boiler feed pump can be calculated, allowing some margin for a ruptured tube and so forth. Simultaneous readings of boiler feed pump suction pressure, discharge pressure, and the other pressures we have mentioned will give the actual requirements of the pump under practical operating conditions.

Consult manufacturer

These data should then be submitted to the pump manufacturer for his recommendation as to what, if anything, might be done toward reducing the amount of power required by the feed pump. This is usually accomplished by either the removal of one or more pump impellers, or by turning off some metal from the diameter of the impellers and so reducing the pressure developed by each impeller or stage of the pump. A careful check also should be made on the provision of automatic low-flow bypass control for the pumps. These are important since the amount of water flowing through these bypasses represents a tremendous



Worthington Corporation

Boiler feed pumps are worst offenders among auxiliaries for wasting power. Reductions in power wastage of 5 to 10 percent are often possible here.

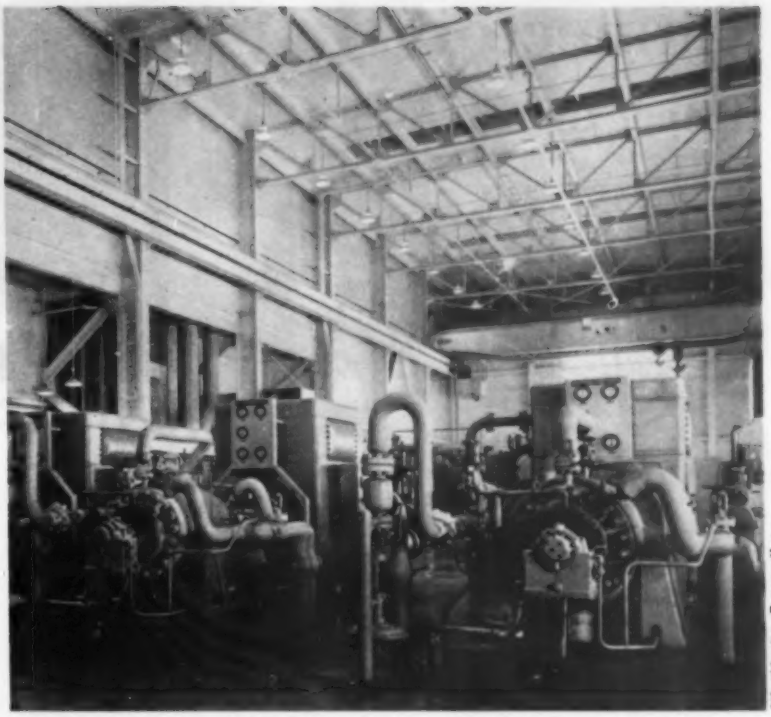
power loss because the average unit operates approximately 8000 hours per year. Reduction in power required for boiler feed pumps has been reduced as much as 5 to 10 percent by such corrections.

Induced draft fans are another source of large power consumption. In some rare cases these are grossly oversized, and in other cases they are only barely sufficient for the normal expected output of the boiler. This should be carefully investigated by running the boiler at the manufacturer's rating to determine the margin in the induced draft fan design. It is to be assumed, of course, that the combustion control equipment has been previously calibrated, adjusted, and is in proper working condition. Controls for the induced draft fan should be carefully checked. Control may be by means of a variable-speed mechanism or damper. Travel and operation of the operating controls should be carefully checked to see that they perform as they should. Ductwork elbows should be checked to be sure that they are not causing excessive pressure drop. If so, the use of turning vanes should be investigated. This work can be best carried out with the assistance of the service engineer of the combustion control manufacturer and the fan manufacturer's representative.

Check condenser water

Condenser circulating water should also be checked. There is usually sufficient data about the water supply so that the pumps are tailored to suit the actual hydraulic conditions involved, but there are certain operating procedures that must be checked. Proper vents should be provided on the condenser water box so that air may be bled off. Boxes should be filled completely with water and all tubes should be flowing water. It is always advisable to check the seal on the condenser drop leg to ensure that it is adequate and that the greatest possible recovery of this downward-flowing water stream has been made. In other words the condenser syphon effect should be used fully.

Forced draft fans do not usually present difficulties, because they handle relatively cool, clean air. Nevertheless they should be carefully checked to see that air is delivered at the required pressure through the air preheaters to the burner boxes in accordance with the manufacturer's requirements. Obviously, delivered air volume should not grossly exceed the manufacturer's stated requirements. If a combination of both excess quantity and excess pressure is found, then the forced draft fan can also join the ranks of the power eaters.



Worthington Corporation

Lighting should be sufficient for safe operation. But power is not free just because it is generated in plant. Many lights can be turned out during day.

Check firing equipment

A check should be made of the fuel preparation and firing equipment to ensure that the power demand is as it should be. All that remain now are the miscellaneous services. Here again, a careful check and review of the miscellaneous pumps, surge tank pumps, air compressors, and other devices should be made to see that only those actually required are operating, and that they are in proper operating condition. Often, it is found that metal chips and dirt are lodged in pump impellers, cutting down the delivered quantity of water. This results in two pumps working instead of one, and therefore wastes auxiliary power.

Plant lighting is another potential source of waste. Operators often assume that the electrical energy required for lighting costs little or nothing, and lights are switched on 24 hours a day. Expensive lamp replacement adds to the cost of the energy used. A rule should be religiously enforced that all lights required for safe operation are to be on, but those not necessary for operating purposes are to be turned off, particularly during daylight hours.

Heat rate of a thermal generating plant is expressed in Btu/net kwh. Greatest possible energy must be delivered to the outgoing feeders with the minimum of internal wastage. It is therefore of the greatest importance to carefully review the amount of service power being used and to reduce this to the lowest possible amount. Careful, painstaking work can often reduce the service power usage to a lower figure and secure thermal performance that is much higher than the designers ever dreamed was possible.

Connectors
Speed Changeover

JOHN P. O'BRIEN
Vice President
H. G. Martin Inc.

W. J. CLARK
Field Engineer
Burndy Engineering Company Inc.

Pressure-indention method of connecting cables to terminals speeded operation and resulted in substantial savings.

HOW WOULD YOU replace outmoded switchgear in your electric generating plant without costly shutdown?

Replacement of some 18-year old switchgear equipment was necessary in the Refined Syrups and Sugars, Inc. electric generating plant, Yonkers, N. Y. Because sugar and syrup refining processes are continuous, interruptions or shutdowns can have serious consequences. Consequently, it was necessary to make the changeover from old equipment to new during the normal unproductive periods.

As a result, it was decided to build a temporary bus structure that would serve until the old equipment had been removed and new equipment put in place and connected. Since speed as well as economy was very important, the contractor decided to use short-barrel connectors that are fastened to the cable by indenting tools that deform the connector barrel into the conductor material.

Temporary bus was constructed in the H. G. Martin Company shop and combination fuse and cable connectors were used as protective devices. These combination connectors protected the conductor and associated equipment while it was connected to the temporary bus. The bus was erected and placed on a platform almost directly above the old switchgear that was being replaced. There were a total of eleven 3-phase circuits involved. Most of the wire sizes were 500 mcm, but there were a few 4/0 and one or two 750 mcm circuits. Combination fuse and cable connectors were bolted to the temporary bus and cable terminals were bolted to the studs on the combination connector base.

It was decided to do the work on Sunday when the plant was nor-

Quick connectors made changeover from old switchgear (left) to new (right) possible without any interruption of process.

mally shut down for an eight-hour period. It was still a lot of work to accomplish in this short time. Use of compression connectors, however, made the job a success.

The first Sunday shutdown involved disconnecting the old equipment and bringing conductors to an enlarged pull box adjacent to the temporary bus. Connections were then made from the load busses of the old equipment to the temporary bus. Jumpers for this purpose were made out of lengths of the correct size conductor with terminals at each end. One end was connected to the load bus for the old equipment and the other end was connected to the temporary bus on the platform above.

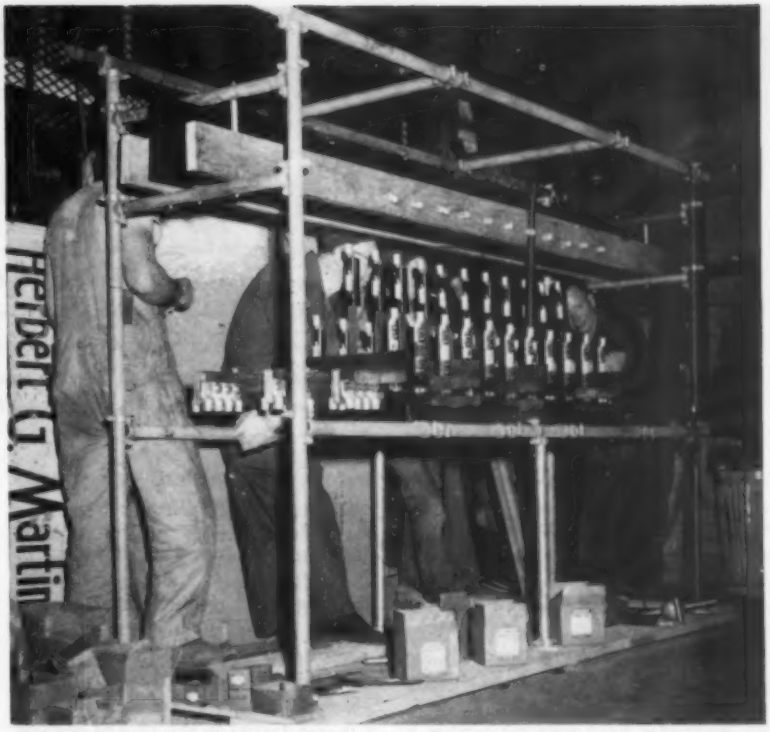
Process was not interrupted

Plant operations were resumed Monday morning with the temporary bus energized and with no interruption of schedule. In the meantime, the old equipment was removed and new 480-volt main switchgear was installed. New conduit and conductors were installed and brought into the enlarged pull box near the temporary bus. Completion of this operation readied the plant for another Sunday shutdown and reconnection to new bus.

Again the shutdown was made and connections were cut off the temporary bus. Conductors were spliced with short-barrel connectors that are fastened to the cable by tools that indent the connector barrel into the conductor material. New switchgear was connected to the load bus, and the job was finished without interrupting process.

Beside the speed of installation, the contractor was interested in the large saving effected. In addition to other pressure-indentation connectors, the contractor used approximately one-hundred 500 mcm terminal lugs for the job. Beside savings in initial cost, the pressure-indentation method gives a more reliable connection. The tool has a built-in automatic overload valve that tells when the connection is properly made and completed.

This is the answer to how Refined Syrups and Sugars, Inc. accomplished the changeover. Use of modern equipment and methods saved valuable working time, prevented costly cleanout, and resulted in superior connections.



Temporary bus was fabricated in shops of H. G. Martin, electrical contractor. Pre-built bus unit was moved intact to plant for quick connection to system.

Simple, one-man operation using hydraulic indenting tool forms terminal onto cable end. Automatic overload valve indicates when proper connection is made.

Part III

Direct Current Machinery

G. C. BLALOCK
Professor of Electrical Engineering
Purdue University

Start right here and now to brush up on your electrical background. Each article in I&P's Electrical Refresher will cover some basic facet of electrical engineering that will help you do your job better. Single sets of the complete Electrical Refresher series will be available without charge. Send in your request now and we will hold it until the complete set is available. Quantity prices upon request.

FARADAY DISCOVERED that an electromotive force is induced in a conductor when there is relative movement cutting magnetic flux across the conductor. Movement, or change, in flux may be effected by

a) conductor moving through or across a stationary magnetic field,
b) magnetic field moving across a stationary conductor, or
c) changing of number of flux lines enclosed within turns of a coil.

This first technique is used in dc generators, the second in ac generators, and the third technique is used in transformers.

Laws governing voltage induction may be stated as follows:

LENZ' LAW: Change in magnetic flux passing through or linking with a closed circuit causes electromotive force in a direction such that the change is opposed.

FARADAY'S LAW: Induced voltage is proportional to the *rate of change* of flux enclosed by a coil, or to the *rate of flux cutting* by a conductor moving across a flux field.

Electromotive force induced by methods a) and b) above follows the so-called *right-hand rule*. Thumb, forefinger, and middle finger of the right hand are held mutually perpendicular. Thumb points in the *direction of conductor movement* relative to the magnetic field — regardless of which does the actual moving. Forefinger points in the *direction of the magnetic field*. Middle finger then indicates *direction of the induced voltage*.

Direction of electromotive force induced by method c) is such that the resulting current sets up a magnetic field in opposition to the flux change that originally induced the electromotive force.

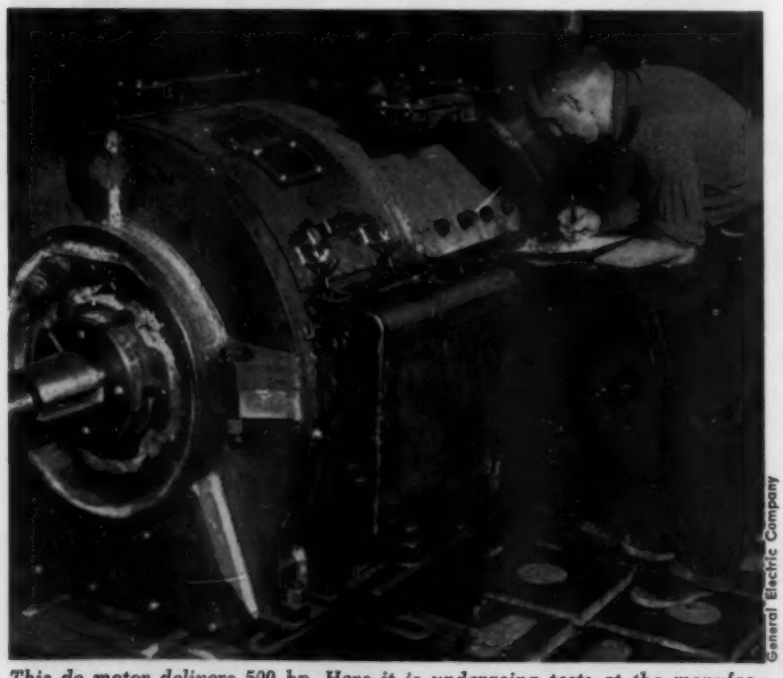
Faraday's Law indicates that induced voltage is proportional to rate of flux change or rate of flux cutting. One volt is the value induced in a coil of one turn when the flux linking the coil is changing at the rate of one weber, or 10^8 maxwells, per second. For movement of a conductor through a uniform flux field at constant velocity, and at right angles to the field, voltage induced may be calculated

$$E = NBLV \times 10^{-8} \text{ volts} \quad (1)$$

where β = flux density
L = length of conductor
V = velocity
N = number of conductors in series

Units in which B, L, and V are expressed is immaterial, if in a consistent system. Product of these three factors will be "flux lines cut per second" in any consistent set of units.

If velocity is not constant, or if the field is not uniform, value of induced voltage will vary from one instant to the next. Average value,



General Electric Company

This dc motor delivers 500 hp. Here it is undergoing tests at the manufacturer's plant. Note protruding thermometer to measure internal temperatures.

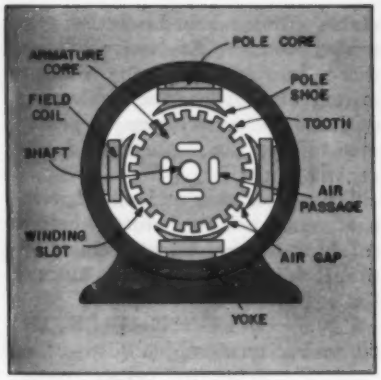


Fig. 1—General arrangement of parts is the same for motor or generator.

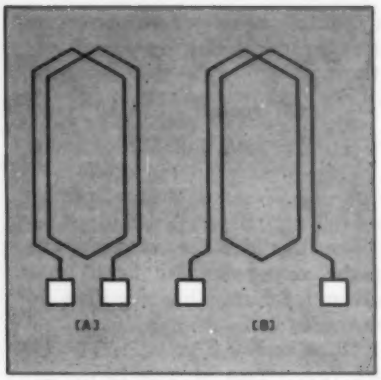


Fig. 2—Coil A is for lap-wound armature. Coil B is for wave winding.

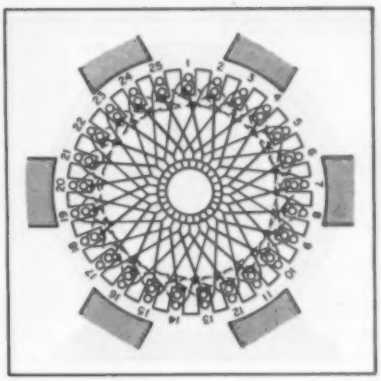


Fig. 3—Complex, repetitive pattern shows how coil ends are connected.

however, over a specified interval may be obtained by dividing total change in flux, or total flux lines cut, by elapsed time.

$$E = N \frac{\phi}{T} 10^{-8} \text{ volts} \qquad (2)$$

where ϕ is expressed in maxwells and T in seconds. If ϕ is expressed in webers, the factor 10^{-8} will be eliminated.

Voltages induced in conductors

When conductors are mounted upon an armature *core* of magnetic material—usually steel laminations—and rotated between alternate north and south magnetic poles, voltages will be induced or *generated* in the conductors.

By employing a symmetrical arrangement of conductors and by connecting them to *commutator* and *brushes*, voltages generated by individual conductors may be added until adequate voltage is attained for a useful load.

Fig. 1 shows general arrangement of parts—except coils and commutator—of a 4-pole dynamo, suitable as either generator or motor. As a generator, the armature must be supplied with mechanical power for rotating it against the counter-torque due to the electric load connected to it and to the friction inherent in the machine. As a motor, it must be supplied with electric power—volts and amperes—for rotating it against the counter-torque of the mechanical load to which it is connected as well as against friction and other *losses*.

Winding unit for closed-circuit armature is a coil such as shown in Fig. 2. Vertical portions represent *inductors*, which are placed in *slots* running lengthwise along the armature. Squares at the bottom of the diagrams represent commutator bars to which coil ends are connected. Each coil may have a number of *turns* between its ends, each turn including two inductors and necessary *end connections*. Width, or span, of the coil will approximately equal the distance between centers of adjoining poles.

Windings formed when slots are completely filled with insulated coils, symmetrically placed as shown in Fig. 3, may be divided into two classes according to the number of *paths* by which current can flow through the armature. Distinction is due to the different methods of connecting coil ends to the commutator.

Chief characteristics of the *lap-wound* armature are that (in its simplest form) it divides the winding into as many paths as there are poles on the field structure and that it requires as many brush sets as poles. *Wave-wound* armatures provide only two paths through the armature regardless of the number of poles, and require only two brush sets—but may be given as many brushes as poles.

Wave winding is best adapted to relatively high-voltage, low-current armatures. Lap winding is better for relatively low-voltage, high-current armatures.

Third type of winding sometimes used, called a frogleg winding, is a combination of lap and wave types, occupying same slots and connected to same commutator segments. In effect, two sets of coils operate in parallel. This saves some slot space and labor in forming coils. It also has an advantage over the lap winding, requiring no *equalizer connections* between different winding sections to prevent voltage unbalances between winding paths.

In very small motors and generators, magnetic field in which armature inductors rotate may be provided by permanent magnets. North and south poles alternate around the machine frame. Electromagnet poles—energized by coils wound around cores of soft iron or steel—provide a more flexible setup since field intensity may be easily varied by controlling current through field coils. Fig. 4 indicates flux paths in a four-pole machine—no coils being shown on either field or armature cores.

Series or shunt fields

Field coils may have many turns of relatively small wire, being thus designed to carry small currents provided by a source separate from the machine or from the terminals of the machine itself. On the other hand, it may have fewer turns of relatively heavy wire, being designed to carry the armature, or line, current of the machine. Fig. 5 illustrates these connections for field coil excitation.

Small auxiliary poles, called *interpoles* or *commutating poles*, are usually included between the main poles. Main function of such poles is to control necessary reversal of currents by the commutator, and

Fig. 4—Flux paths in four-pole machine (coils not shown for clarity).

to eliminate sparking at the commutator and brushes.

Voltages induced in armature coils reverse in direction as the armatures rotates, carrying the coil sides past flux fields of opposite polarity. A reversing device, the commutator bars and brushes, is necessary, therefore, if the circuit voltage and currents are to be unidirectional rather than alternating.

Armature coil ends are connected to individual commutator bars in such manner that, with assistance of the brushes, the armature winding is divided into a number of paths. Each path generates the line voltage, and conducts its share of the total line current. Since armature coil currents reverse when the coil ends pass contact with the brushes, there is a natural tendency to spark at the brushes. This is reasonably well controlled by adjusting brush position or by the commutating poles.

Basic equations for voltage induction, Equations 1 and 2, become applicable to dc generators or motors in the following form:

$$E = \frac{Z}{\text{paths}} (\phi) (\text{poles}) \frac{\text{rpm}}{60} 10^{-8} \text{ volts} \quad (3)$$

where Z = total number of inductors on the armature
ϕ = magnetic flux lines per pole

Since the number of inductors, paths, and poles are fixed for a given machine, this equation reduces to

$$E = K \phi S \text{ volts} \quad (4)$$

where S = rpm of armature
and K = the product of constant factors.

Where field current is supplied from an auxiliary source—that is, *separate excitation* as distinguished from *self-excitation*—there is no *voltage buildup* problem such as exists with self-excited generators. All that is necessary to generate voltage is to supply current to the field coils and to rotate the armature.

But with self-excited, generators, whether of the shunt, series, or compound type, voltage must be built up to proper value. This build up starts with small voltage obtained by rotating the armature inductors at full speed through the residual flux remaining from the last time the machine was used.

Determine stable point

Referring to Fig. 6, magnetization is plotted between field amperes and generated voltage. Curve is not a straight line, but bends to the right as field magnetic circuit approaches saturation. Field resistance line is a straight line whose slope is the field-circuit resistance. Crossing point of the two is the stable point reached by the generated voltage. At lower voltage, more than self-sustaining voltage, is generated. Above the stable voltage, insufficient voltage is generated to keep the required field current flowing.

When operating under load, voltage generated is reduced before reaching the machine terminals by the IR drop in the armature circuit. Thus

$$V = E - I_a R_a = K\phi S - I_a R_a \quad (5)$$

where V = terminal volts,
E = generated volts,
I_a = armature current,
R_a = armature circuit resistance.

Under load conditions, generated voltage is reduced somewhat because of the *armature reaction* which reduces flux below its no-load value. Fig. 7 shows the result of these factors in determining shape of the external characteristic curve for a separately excited generator.

In self-excited shunt generators, a third factor—reduced excitation caused by the decreasing terminal volts—causes voltage curve to drop still more, as shown in Fig. 8.

Compound generator, a portion of its field winding in series with the armature or load circuit, may have its voltage characteristic essentially level from no-load to full-load. It may have a surplus of turns for added excitation so that its voltage actually *rises* with load current. This overcompensation automatically compensates for the line voltage drop, between generator and its load, which increases as load increases.

Essentially the same machine may be used as generator or as

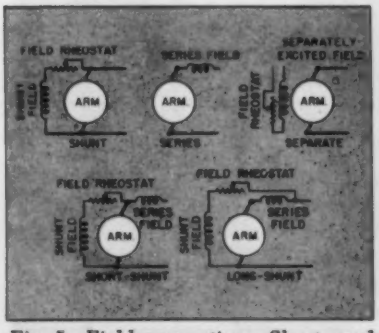


Fig. 5—Field connections. Short- and long-shunts are compound machines.

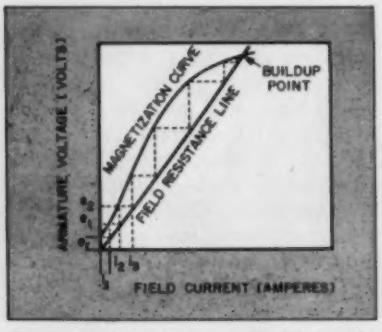


Fig. 6—Buildup point is the stable point where generated voltage settles.

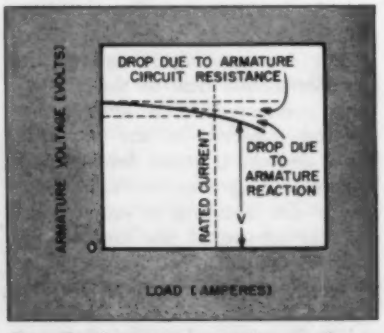


Fig. 7—Armature reaction reduces field flux, reducing generated voltage.

motor. When operating as generator, mechanical power is transformed into electric power. Electric power is transformed into mechanical power when operating as a motor. This reversal in function is brought about, other factors remaining unchanged, by reversal in direction of armature current. Through Equation 5, with armature IR drop *added* to the generated voltage, applied voltage becomes *greater* than the generated voltage by the amount of the I_aR_a drop. Thus

$$V = K\phi S \pm I_aR_a \qquad (6)$$

applies to generators when the negative sign is used, and to motors when the positive sign is used. Generated voltage in motor action, called *back* electromotive force becomes the current—input regulator. Thus, from Equation 6,

$$I_a = \frac{V - K\phi S}{R_a} \qquad (7)$$

As mechanical load rises, speed decreases—resulting in increased current input and additional development of torque. Torque developed by a motor depends on variables ϕ and I_a, so that it may be expressed

$$T = K_2\phi I_a \text{ lb-ft.} \qquad (8)$$

Factor K_2 is not quite the same as the factor K in Equation 6, but includes many of the same machine constants. Horsepower output varies with torque and speed, and is expressed

$$hp = \frac{2\pi ST}{33000} \qquad (9)$$

where S = rpm

T = output torque in lb-ft.

Characteristics of motors, like those of generators, are determined by methods for obtaining excitation or magnetic flux in the machine air-gap. Referring to Fig. 5, the same connections with exception of diagram (c) may be employed for motors as for generators.

Typical torque and speed curves for the three types of excitation—shunt, series, and compound—are shown in Fig. 9. These show shunt motor to have excellent *speed regulation*, variation of speed with load being very slight. Series motor has very poor speed regulation since its speed varies markedly with load changes, and may become dangerously high if load is entirely removed. Compound motor will have speed regulation somewhere between the extremes of shunt and series, depending upon the extent to which its excitation is dominated by one or the other of its field windings.

Plot torque

Torque characteristics also may be compared as in Fig. 10. Torque is plotted against current input—one of the variables upon which torque directly depends. Series motor has a decided advantage over the shunt motor insofar as *starting torque* is concerned—series motor developing greater torque per ampere above rated current.

Back electromotive force developed by a motor armature controls the current input (See Equation 7). Furthermore, back electromotive force is zero (speed being zero) at the instant the starter switch is closed.

Starting voltage, therefore, must be reduced until near-normal speed is attained by the armature. Back electromotive force then can assume control and keep the current within safe limits. This procedure is usually accomplished by inserting *starting resistance* in the armature circuit during the speed-acceleration period. Starting resistance may be reduced to zero in several steps as the armature picks up speed. Hand starters or completely automatic, pushbutton starters may be used.

Combine speed and starting

Many starters embody speed control as well as starting control. For shunt and compound motors, speed control may be achieved by varying resistance in the armature circuit or in the shunt-field circuit—latter method being most satisfactory and efficient, in general. For series motors, usual control involves variable-resistance controller that serves both for starting and for speed control.

Many types of starting and speed-control resistors employ devices for automatically disconnecting the motor from the supply line when an overload current increases windings temperature to a point that threatens damage to the insulation. Control also disconnects the motor in case supply voltage should drop appreciably below proper operating value.

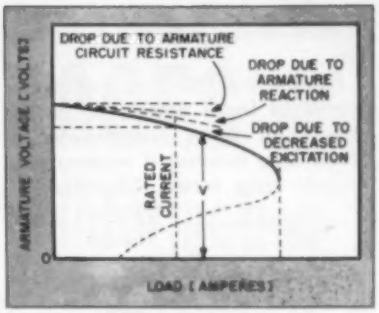


Fig. 8—Self-excited machine can be overloaded to instability (dotted line).

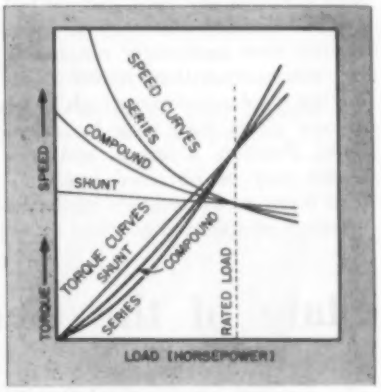


Fig. 9—Torque and speed curves show comparative performance well.

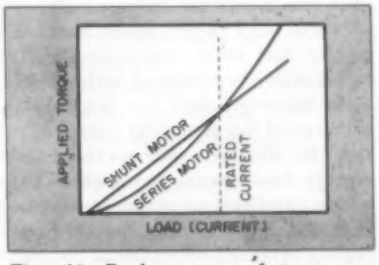


Fig. 10—Performance plots same whether load is in amperes or hp.

Certain power and energy losses are necessarily involved in the operation of generators and motors. *Electric losses* are due to current passing through conductors. *Mechanical losses* are due to friction and windage. *Core losses* are due to molecular friction in the reversal of magnetic flux through iron or steel cores on which conductors are wound. Power or energy output of the machine, therefore, always will be less than the input. Difference is the losses,

transformed into heat and usually wasted—hence referred to as *heat loss.*

Efficiency is the ratio of output power to input power, or output energy to input energy over a given time interval if necessary to include time factor. Therefore

$$\text{Efficiency} = \frac{\text{Output}}{\text{Input}} \quad (10)$$

$$= \frac{\text{Output}}{\text{Output} + \text{Losses}} \quad (11)$$

$$= \frac{\text{Input} - \text{Losses}}{\text{Input}} \quad (12)$$

Efficiency of a given generator or motor may be obtained by direct measurement of input and output power. Usually efficiency is more readily and accurately obtainable by measurements—without loading the machine—from which losses at any given load may be calculated. Friction, windage, and core losses may be obtained from no-load input measurements while the machine is operated at rated speed and at its rated field excitation.

Armature and field-circuit resistances may be measured with the machine idle. These losses are then calculated as I^2R watts, using the current value that applies to the load condition for which the losses are being calculated. Efficiency then may be calculated using the foregoing efficiency equation that best applies. Equation 11 is usually best suited to generator calculations. Equation 12 is usually best suited to motor calculations.

Early generation and distribution systems used dc equipment, but ac apparatus soon demonstrated its general superiority. Dc generators are now limited to special applications such as exciters for large ac generators, as special power sources for dc motors, and as power sources in automobiles and railway cars.

Dc motors, on the other hand, have held their own in competition with ac motors over the years. Because of its wide range of speed control with good speed regulation at all speed levels, the shunt motor is preferred where speed adjustment is essential and where starting-torque is not severe. For moderately heavy starting loads, a light series field winding may be added. Heavier series winding may be supplied for additional starting torque, at the expense of good speed regulation.

For really severe starting conditions, particularly where an operator is always in attendance and where good speed regulation is not a major factor, the series motor has little competition. Limiting factor with the series motor is its tendency to run at excessive speed when load is entirely removed. It must be geared to its drive with sufficient load to hold speed to a safe value under lightest-load conditions anticipated.

State of the electrical art

REPORTING on the progress of the art and science of electricity at this moment in history is a task to defeat an intellectual Hercules. . . . In the first place, it is apparent that the electrical engineer ministers not only to the great common public, but even more specifically to his sister branches of technology. It is apparent that the traditional services of the electrical engineer in the transfer of information and energy have expanded so that the entire intellectual world of science and industry awaits his services. Newly oriented educational courses are being given to our young men. The engineering world is changing. The electrical engineer can now do almost everything except foretell the future, although for thirty years he hasn't been doing too badly in power load and communication traffic forecasts. . . .

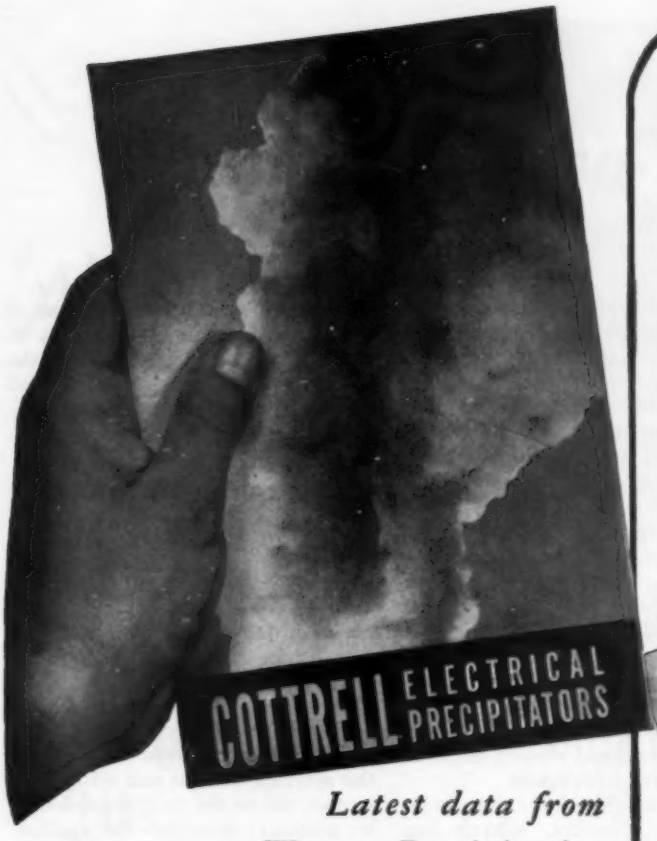
Energy supply and transfer devices are becoming bigger and better. Generators of over 300,000-kva capacity are not uncommon, and half-million-kva machines are in sight. These are, of course, made possible by the use of gaseous or liquid coolants. 300,000-kva transformers are already being left behind. The January issue of Electrical Engineering shows a picture of a motor rated over 100,000 hp. This single motor represents an output equal to the total sustained muscle power of the whole population of the United States in Benjamin Franklin's day. Circuit breakers no longer seem to be a limiting feature, 10,000,000-kva being a common rating with higher ratings in sight. The trend of power supply system development is toward transmission and distribution of greater amounts of energy over more widely dispersed areas. Higher voltages are in order, with 300- to 400-kva transmission being operated and more planned.

Industry follows the same pattern of bigger, better, more automatic operations. The great steel industry, symbol of size, uses transistors and magnetic amplifiers for fine control. The new steel plants, such as the Fairless plant in the Delaware River Valley, are replete with electricity supply and electronic control devices. Every production engineer everywhere is occupying himself with automation. The carrying of heat to a proper place whether for welding, for stress relieving, for processing, or what not is an electrical function.

New accomplishments are being made with lighting. Lighting, like the other children of electrical engineering, is rapidly expanding, lumen-hours having tripled in ten years. A 200-million candlepower short-arc mercury searchlight is being used for airport use. On the other end of the scale, low-power completely diffused illumination through electrically excited paint is under development.

With today's electrical accomplishments so far beyond anything that yesterday dreamed of, who is able to unleash an imagination competent to picture tomorrow . . .? Had [Franklin] been born 200 years later, his fertile imagination could have taken up the challenge that today's accomplishments present us. Direct conversion of the energy of nuclear fission into electrical energy would surely have been one of his concerns. He may have been weak in imagining the extreme complexity of the electrical controls and devices used today in handling these infinite wells of energy, but he would have been among the first to foresee the brave new world which such possibilities presented.

M. D. Hoover
President, AIEE



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- Various types of Collecting Electrodes (rod curtains, corrugated plates, pocket electrodes, etc.).
- Typical ways of removing collected material.
- Various Shell Constructions (steel, concrete, brick, etc.).
- The effect of various factors on efficiency and performance.
- Data on CMP (Combination Multiclone-Precipitator) Units.

. . . and many other helpful facts on Cottrell design and operation.

Latest data from Western Precipitation on Cottrell Recovery Equipment

Do you have operations in your plant where gas-laden suspensions, wet or dry, are a problem? Such suspensions may be dropping on surrounding property, causing nuisance difficulties. Or perhaps important values are being lost in stack gases that can be profitably recovered. Whatever the nature of your recovery requirements, you will find this 40-page Cottrell booklet of great help. It contains up-to-date data on the latest advancements in the electrical precipitation field – prepared by the organization that pioneered the commercial application of Cottrell Electrical Precipitators almost a half century ago and has consistently led in new Cottrell developments.

A copy of this data-packed booklet will be sent free to engineers and other executives interested in recovery processes. Send your request to our nearest office.

For nearly 50 years Western Precipitation has carried on a continuous research and development program on Cottrell Electrical Precipitators, Multiclone Mechanical Collectors and other types of recovery equipment. We are not affiliated with any other company in the electrical precipitation field except our wholly owned subsidiaries, International Precipitation Corporation and the Precipitation Company of Canada, Ltd. We are equipped to serve you anywhere in the United States, Canada, and throughout the world!

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In brief . . . .

AIEE Winter General Meeting

SO MANY papers pertaining to Industry's Power Services were presented among the 500 titles at the AIEE Winter General Meeting that INDUSTRY & POWER continues last month's "in brief" coverage of that meeting with the following:

What do losses cost?

V. W. Ruskin
British Columbia Electric Co., Ltd.

"Electrical losses are commonly evaluated by separately calculating and adding two components:

"a) The Energy Component, which is the cost of supplying the kilowatt hours of energy dissipated by the losses.

"b) The Demand Component, which is the annual charge associated with the investment in plant tied up by the kilowatt peak demand of the losses.

"Many aspects of calculating these components have been treated in previous papers, but two basic factors vital to any loss evaluation have never been properly assessed, namely:

"1) What is the cost of supplying a kilowatthour of loss energy in different types of systems — thermal, hydro, and combined hydrothermal? Also should average or incremental, historical, or future costs be used?

"2) What is the investment in these different types of systems that is tied up by one kilowatt of the losses?"

Hydraulic operation for low-voltage breakers

H. L. Peek

M. G. Dyer
Allis-Chalmers Manufacturing Co.

"Designer of low-voltage switchgear is continually confronted with two conflicting demands: first, the requirement for reducing the space occupied by the switchgear and second, the requirement to increase the interrupting capacity of the breakers which must be installed in the allotted space of the switchgear enclosures. The higher interrupting capacity requirement brings with it the requirement to be able to close against higher momentary ratings—thus requiring a more powerful operating mechanism, which usually requires a greater portion of that allotted space.

"The solenoid, which is still the conventional power source for low-voltage circuit breakers, requires exceedingly high currents to supply even marginal closing effort in the small available space.

"It is natural, then, that high-pressure hydraulics, which has proved so successful in aeronautical and automotive practice and more recently has proved equally successful in high-voltage circuit breaker operators, should be extended to the low-voltage circuit breaker field where it can solve the problem of great power in small space and because of its ability to respond without heavy shock to the abruptly changing loads imposed during breaker closing stroke."

Motor relay protection in steam power stations

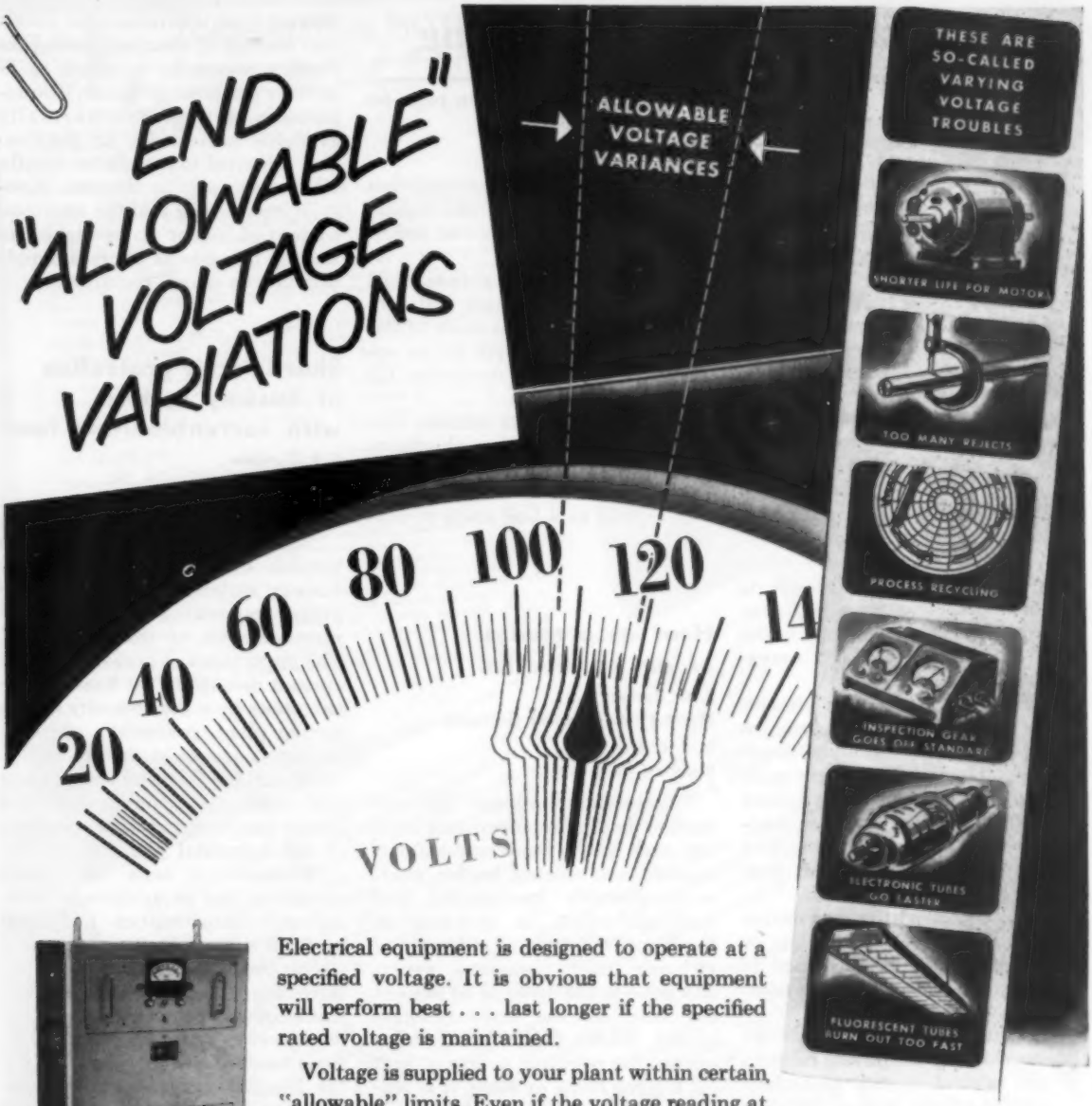
W. F. Neff
Ohio Valley Electric Corp.
S. H. Horowitz
American Gas and Elec. Service Corp.
R. B. Squires
Westinghouse Electric Corporation

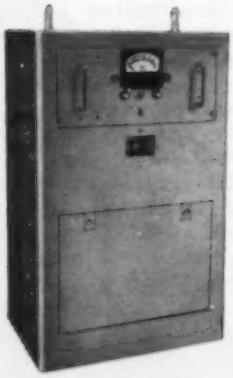
"We have attempted to list the many factors involved in choosing the relaying circuits and settings on motors connected to a grounded 4-kv auxiliary bus. Specific applications must be tailored to the individual problem but certain general conclusions can be stated:

"1) Short-circuit protection should be provided with instantaneous tripping. This can be accomplished through plunger-

Edison Medal is awarded L. A. Umansky, General Electric. Looking on are F. M. Roberts, General Electric, (left) and E. P. Yerkes, Bell Telephone of Penn.

END "ALLOWABLE" VOLTAGE VARIATIONS





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AIEE Winter General Meeting

. . . starts on page 60

type relays, instantaneous attachments, or short-time induction disc relays — with latest results indicating preference for the induction relay.

"2) Instantaneous settings should be above maximum inrush, including offset, but not to exceed one-third of the total fault current.

"3) Phase overload relay current settings should be determined by the normal operating current with advantage being taken, if necessary, of the service factor of each motor.

"4) Lever settings of above relays should be just high enough to allow starting, plus sufficient margin to cover voltage variations and temporary emergency overloads.

"5) Overload settings are presently being determined empirically. Motor manufacturers should be urged to supply more specific information on locked rotor currents and temperature limitations of the motors under normal load and overload conditions.

"6) Some form of thermal device for tripping, load reduction, or alarm should be provided to supervise the actual temperature of the motor.

"7) Ground protection should be provided by a separate relay in the neutral of the secondary circuit of the motor CT's, or with a CT specially designed to eliminate error current."

Extruded high-strength aluminum for electric bus

W. Swihney

C. L. Carlson
Westinghouse Electric Corporation

"Several aluminum suppliers have developed a new extruded and heat-treated, high-strength aluminum alloy having a minimum electrical conductivity of 55 percent of the International Annealed Copper Standard. This alloy provides a new source of suitable electrical bus conductor material for the rapidly expanding electrical power industry.

"Current-carrying tests, performed on various sizes and configurations of bus bars made of this new material, give data for its application as a bus conductor for electrical equipment.

"Short-circuit tests indicate that a bus made of this new aluminum alloy can withstand electromagnetic forces due to fault currents just as well as a bus made of copper."

Heat as a means of air purification

J. C. Beckett
Wesix Electric Heater Company

C. E. Clifton
Stanford University

"These studies support the contention that high-temperature heaters, such as the more conventional incandescent electric heater, exert a considerable bactericidal and sporicidal effect. In operation in the home, the rates of reduction of airborne micro-organisms generally were in the order of 50 percent per hour for the more resistant spores. Where these electric heaters are the principal source of heat for a given home or room, it is reasonable to expect that the micro-organism content will reach a very low level after several hours' operation.

"It is clear that a considerable portion of the air which circulates around the heater may not soon pass close enough for the organisms contained therein to be destroyed. It takes several hours' operation to achieve a stable minimum condition. The germicidal action appears to be much more rapid than that observed with ultraviolet lights as ordinarily placed in a room, but not as fast as with the use of a chemical material such as propylene glycol vapor. . . .

"Electric heaters of the incandescent type will reduce the microbial content of room air during the heating season by as much as 50 percent per hour or better. The application of these commercially available heaters for air purification is limited to the winter months when heat also is desired. However, considering that the microbial content of indoor air is highest in winter, this means offers a simple solution to most requirements."

Short-circuit protection of busway systems with current-limiting fuses

J. B. Cataldo

N. Shakman
BullDog Electric Products Co.

"Methods for providing the best possible short-circuit protection of busway systems continue to be of prime importance to users and manufacturers of this equipment. The importance of preventing fault current damage to the busway system arises from the necessity of protecting plant personnel, the high replacement cost of the equipment itself, and the financial and productive losses occurring through the forced inactivity of large sections of the industrial plant. . . .

"Short-circuit tests have been conducted and an analysis of time-current characteristics has been made of current-limiting fuses and circuit breakers for purposes of determining the improvement in short-circuit protection provided for busway systems. The conclusions reached are as follows:

"1) Busway systems can be employed where available fault currents are in excess of their ratings when protected by current-limiting fuses.

"2) Maximum protection against arcing faults is obtained by employing the lowest size current-limiting fuse consistent with the overload characteristics of the circuit.

"3) The combination of current-limiting fuses and circuit breakers provides the maximum overall protection for busway systems.

"4) Added protection for existing busway systems can be accomplished practically and economically."

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CONRAD N. HILTON, PRESIDENT TRUETT GORE, GENERAL MANAGER

The North American Mogul Products Company
Standard Building
Cleveland 13, Ohio

Gentlemen:

In the thirty years of my experience in the Power Engineering field, which covers power plants in industry, large office buildings, hotels, institutions, etc., I have never before felt compelled to write a letter of praise for any product used in my plants.

This letter is not only one of praise for the North American Mogul Products, but is to pass along to other engineers in charge the benefit of my personal experience with these products for the past three years.

The Deshler-Hilton Hotel, together with the LeVeque Lincoln Tower, cover approximately a city block. The hotel contains 1000 rooms, one portion being 12 floors high and the other being the first 18 floors of the tower building. The balance of the tower - 19th to 46th floor, consists of office space. This building contains two power plants, one high pressure, one low pressure, both capable of operating independently or being operated together. On the high pressure plant I am using #5 fuel oil. On the low pressure plant I am using #6 fuel oil and natural gas.

Three and a half years ago, when I took over as Chief Engineer of this plant, I found the boilers in very bad condition; hot water tanks and hot water risers in far worse condition, and the return lines from the traps on my heating system so clogged that at times during the first winter we were forced to bring the pressure up to 14 lb. and 16 lb. to heat the hotel - and during this time receiving hundreds of heat complaints through the winter, along with hundreds of complaints on our hot water supply. Engineers can easily understand what a terrible burden this is and the labor hours consumed by practically the entire department handling these complaints and trying to correct the condition at the same time. I could cover pages describing the fight to overcome these problems - and here I wish to state that the plant records show three types of treatment had been consistently used in this plant for years before my arrival. Two 52 gal. drums of this former treatment, still in stock a year later, were dumped in the sewer.

Briefly, I will give you the situation that exists as of today: Six weeks ago, when the Insurance Inspector had finished thoroughly examining my boilers, which had not been opened since his examination a year previous, and no treatments whatsoever had been used except the North American Mogul Products, he did not have a single recommendation but one - and that was that it was not necessary to renew the fusible plugs in the boilers. All engineers are naturally proud after an internal examination by the Insurance Inspector, if they are given a clean bill of health.

The last seven occasions that the hotel has been filled to capacity, altogether there has been a total of five calls registering dissatisfaction with the hot water supply. Only two of these calls were associated with the hot water supply. Only two of these calls were associated with a slight restriction on one riser, which naturally will disappear in the very near future.

Our six hot water heaters are kept in excellent condition.

Now in regards to our heating system - We carry from 2/4 to 3/4 lb. of steam, and are maintaining 12# to 14# of vacuum. The latter part of last winter our heat calls disappeared altogether, and we have not as yet received any this winter - except a very few associated with trap elements in need of replacement.

Our cost of fuel during the winter months has dropped 25% to 30% in comparison with fuel costs three years ago.

I wish to express my deep appreciation for the loyal and consistent service and assistance given me at all times by the North American Mogul Products representative in this area.

Sincerely,
J. L. Roles, Chief Engineer
Deshler-Hilton Hotel

4-56

Write us regarding your scale problems.

The North American
MOGUL
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Standard Building
CLEVELAND, OHIO

40 YEARS OF PROGRESS . . . AND STILL GROWING

ideas in action

. . . starts on page 28

Production increased with magnetic separators

Often undetectable presence of nuts, bolts, nails, wire, and very fine iron contamination in materials to be ground was causing frequent damage to screens of Micro-pulverizers at Toms River-Cincinnati Chemical Corporation. A circular Eriez permanent magnetic grate 30 inches in diameter was installed in the charging hopper. Maintenance engineers say the grate has been 100 percent effective, and pulverizer screens rarely need to be replaced because of damage caused by foreign particles. Substantial production gains have been made.

Thrust bearing chart for large vertical motors

More and more vertical ac motors are being used in industry. Manufacturers often differ in what bearings they recommend, which leaves the plant engineer wishing he had something to use when he gets two or more expert but different opinions. This chart gives the general picture of thrust bearing practice for motors of 200 hp and larger. With minor modification, the facts apply to all U. S. motor manufacturers.

Store small parts at lower cost

Small industrial parts cost less to store and handle efficiently in a new type of reusable bag with a self-locking closure. Both the film bag and the closure, developed by Polyfab Company, Los Angeles, are made of Bakelite polyethylene. Light thumbnail pressure locks edge of the new closure, sealing the contents against moisture, air,

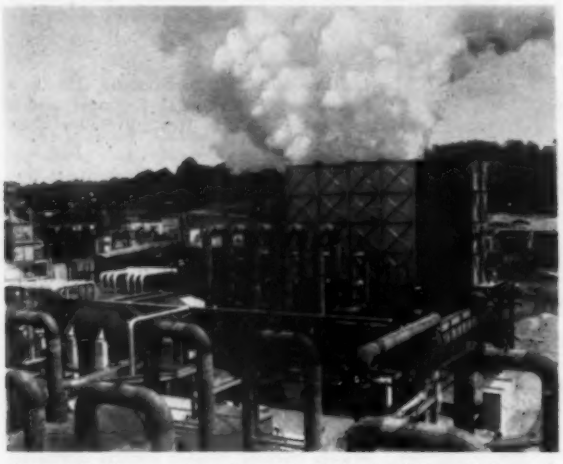
and dirt. Bag edges are easily pried apart, and can be relocked again and again. Contents, including tags or part numbers, are clearly visible to facilitate sorting and inventory. Bags are also made in multiple-pouch form to hold a number of parts separated by sealed partitions to prevent contact between them.

THRUST BEARINGS FOR LARGE VERTICAL AC MOTORS

	BALL BEARINGS Deep Groove or Angular Contract	ROLLER BEARINGS Spherical or Tapered	Thrust Bearings KINGSBURY
THRUST CAPACITY	Low-to-moderate. Can be stacked in duplex or triplex mountings, providing thrust for angular contact type up to 20,000 pounds, depending on speed. Capacity of deep groove type somewhat lower.	Relatively high — up to 100,000 lb., depending on speed.	Very high — up to hundreds of tons, depending on speed.
SPEEDS	Moderate, up to 1800 rpm for grease lubricated bearings, depending on size and duty. Higher where oil lubrication provided.	Moderate — Up to 1200 rpm, depending on duty.	Low, medium or high.
LUBRICATION	Usually grease lubricated. Can be oil-lubricated at higher speeds to help dissipate heat and avoid frequent greasing. Occasionally low speed bearings are oil-lubricated, with bearing partially or completely submerged in oil.	Oil, because of size and complexity of bearing. Generally partly submerged in the lubricant.	Bearing submerged in oil. Rotating collar separated from stationary babbited shoes by film of oil, so there are no rubbing surfaces.
COOLING	By oil, where oil lubrication used.	Rotation circulates cool oil through the bearing. On larger sizes and high speeds, bearing can be water cooled, with cooling coils in oil reservoir.	Viscosity pumping effect of thrust collar circulates oil within the housing and over cooling coils, if provided.
ADVANTAGES	Grease lubricated bearing not as sensitive to mishandling at assembly or during maintenance as oil-lubricated bearing, and operates better in dirty or dusty surroundings. Lightly loaded and capable of handling short-duration overloads of several times design capacity. Deep groove bearings take upward thrust. Accomplished with angular contact bearings by back-to-back arrangement so that one bearing handles upward thrusts.	Available in larger sizes than most other bearings, with inherently greater capacity of rollers over balls. Spherical roller bearings are self aligning, resulting in equal distribution of the load.	Self aligning through action of leveling plates providing equal distribution of load. Accessible for maintenance if required. Available for high speed, high thrust applications. Indefinitely long life, if properly maintained.
LIMITATIONS	Not self aligning, so bearing housings, caps, etc., require close tolerances.	Relatively larger than ball bearings. Do not take upward thrust.	Relatively high first cost. Often requires cooling water supply. Large physical size. Greater friction loss than Anti-friction bearings.
MAINTENANCE	Requires small amount of grease at intervals, per manufacturer's recommendation. Provision made for removing expended grease without costly disassembly.	Lubrication oil must be kept at proper level, changed at intervals.	Lubrication oil must be kept at proper level, changed at intervals.

Special silencers for supersonic research

Escaping gases are quieted and exhausted vertically at Wright Aeronautical Div. of Curtiss-Wright Corp.'s Wood-Ridge, N. J. ramjet testing laboratory. Specially



designed silencers developed by Industrial Sound Control, Inc., channel gases on an undulating course through a series of perforated metal silencers. Free flow design eliminates buildup of back pressure.

Three tubes rolled in a minute

Huge tube rolling and expansion job was recently completed by Baeuerle & Morris Coppersmithing Co., Philadelphia. An Airetool tube expansion control system was used to roll 850 copper tubes in a new sugar refinery calandria. Because of size and weight of the calandria, (steam heating section of a 14-foot vacuum pan)

only half the tubes were rolled before equipment was set in place. Remaining tubes were rolled after calandria was installed in the plant. Tubes were 4 in. od x 13 gauge. Normally, such a tube rolling job would take days to accomplish, but tubes were rolled at the rate of one every 20 seconds.

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. . . personalities from industry & power

Pitts

Hudson

Bohn Aluminum & Brass Corporation names **Guy H. Pitts** manager of Fabrication Division. His new duties will involve supervision of manufacturing operations in six plants in Michigan and Indiana.

Rockwell Manufacturing Company names **Earl Hudson**, formerly assistant general manager of the Dubois gas meter plant, as general manager of the company's new Porterville, Calif., meter and valve plant. Hudson was selected on the basis of nearly 20 years' experience in production, purchasing, personnel, and other administrative positions.

Laclede-Christy Division, H. K. Porter Company, Inc., appoints **Rex D. Cross** vice president-sales. Cross was formerly an independent management consultant in Los Angeles and earlier was general sales manager of Johnston Pump Company.

Worthington Corporation announces promotions. **I. J. Karassik** becomes assistant to vice president and staff consulting engineer. **L. H. Garner** becomes manager. **R. Carter** becomes public works consultant and manager of Volute Pump Section. **T. W. Edwards** becomes manager of Boiler Feed Section. **R. T. Carrico** becomes manager of Marine Section. **W. P. Spinning** becomes assistant to manager, Steam Power Department. **A. L. Jones** becomes manager of Deaerator Section, Steam Power Department. These engineers represent a combined total of 172 years' experience and service with the company.

American Society of Heating & Air-Conditioning Engineers elects **John W. James,** vice president of research for McDonnell & Miller, Inc., president. James is well known as a consulting engineer, research director, teacher, and author of many papers and books on heating and air conditioning. He is a Registered Professional Engineer and a member of ASME Heating Boiler Code Committee.

National Association of Corrosion Engineers selects **Edward L. Simons** as recipient of the 1955 NACE Junior Award. Simons, a research associate in the General Electric Research Laboratory, was formerly associated with the Manhattan Project. He was assistant professor at Rutgers University.

Eta Kappa Nu awards **Dr. J. Nelson Grace,** nuclear reactor control specialist with Westinghouse Electric Corporation, honorable mention citation as 1955 outstanding young electrical engineer for his contributions in the field of atomic power, as well as for his professional, civic, and cultural activities.

Hewitt-Robins, Inc. appoints **Martin Vander Laan** manager of operations, Engineering Division. Vander Laan recently served as consultant to US Government's Foreign Operations Administration. He is a well-known expert in every phase of conveyor design and construction.

Becker

Blackburn

Midwest Piping Company, Inc., names **Phil R. Becker** general sales manager. Becker will be responsible for the national sales program of all the company's divisions.

Stran-Steel Corporation appoints **C. V. Blackburn** vice president, sales. Blackburn was formerly with General Electric Company in a sales managerial position. Blackburn replaces J. E. Bowen, who resigned recently. During the war, Blackburn served on the War Production Board as assistant to director, Copper Division.

Electric Controller & Manufacturing Division, Square D Company, names **Asa H. Myles** chief engineer and member of operating committee. Myles has been associated with the company for more than a quarter century. He is a member of Pi Epsilon Mu, an honorary engineering fraternity.

Weston Electrical Instrument Corporation appoints **Samuel J. Childs** vice president and general manager. Childs will be in charge of all company's manufacturing and production.

Dr. Sidney S. Alexander joins faculty at Massachusetts Institute of Technology. Dr. Alexander is widely known for research on economic and industrial problems. He formerly was assistant chief of the statistics division of the International Monetary Fund.

Wellman Engineering Company elects **Robert C. McDowell** president, succeeding Dr. J. C. Hodge. McDowell is also president of McDowell Company, Inc., industrial engineers and contractors.

American Institute of Electrical Engineers announces nominees for officers: **Mervin S. Coover,** head of Electrical Engineering Department, Iowa State College, for 1956-57 presidency.

Those nominated for vice president are: **Donald E. Garr,** assistant division engineer, General Engineering Laboratories, General Electric Company; **Leland F. Stone,** engineer, Apparatus Sales Office, General Electric Company; **J. H. Foote,** president, Commonwealth Associates, Inc.; **Norman F. Rode,** professor of electrical engineering, Texas Agricultural & Mechanical College; **Mansfield M. Ewell,** manager, Engineering & Service Department, Westinghouse Electric Corporation; **Henry H. Kerr,** vice president in charge of operations, Toledo Edison Co.

Directors nominated are: **William R. Brownlee,** Southern Services, Inc.; **Alva A. Johnson,** engineering manager, Switchgear Division, Westinghouse Electric Corporation; **L. M. Robertson,** chief electrical engineer, Public Service Company of Colorado; **Walter J. Barrett,** New Jersey Bell Telephone (also renominated treasurer).

Kewanee Boiler Division of American Radiator & Standard Sanitary Corporation names **Elbert M. Palmer** president. Palmer was formerly executive vice president. He is a veteran of thirty years with the company. He succeeds W. Bradford Russell, who is retiring from active participation in the company. Russell joined the firm in 1933 and was elected vice president in 1945. He will continue as a consultant.

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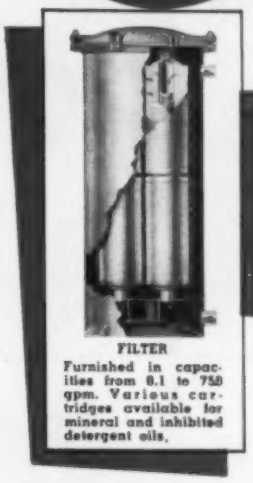

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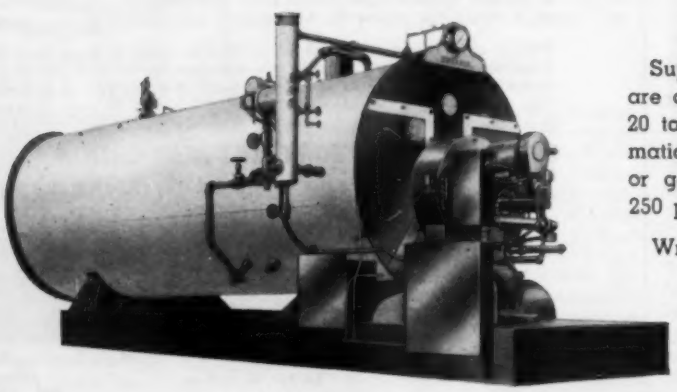

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NON-FLUID OIL "stays alive" longer, lubricates dependably, until entirely consumed, protecting costly anti-friction bearings and prolonging their life. Dollar for dollar, pound for pound, day in and day out, NON-FLUID OIL gives more and better lubrication.

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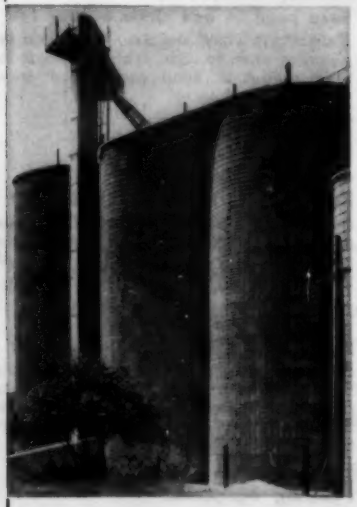

Barytes, cullet, feldspar, limestone, salt cake, silica sand, slag, soda ash—these are the materials handled and stored in Neff & Fry Bins at Foster-Forbes Glass Co., Marion, Ind. Four of the nine bins are shown in the photograph.

It would take this entire space to list all of the flowable bulk materials for which our bins are used. In many cases, considerable ingenuity is required to meet the loading and unloading situations. That's when our engineering knowledge plays an important part.

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handy guide

. . . starts on page 69

Forget hot pumping troubles
Read page 83 and circle number 142
AURORA PUMP DIVISION, THE NEW YORK AIR BRAKE COMPANY. Water jacketed Apco pump, developed especially for handling high-temperature and highly volatile liquids, is unbeatable on high-head, small-capacity duties. Send for free catalog.

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Refractory castables stand up
Read page 4 and circle number 144
THE BABCOCK & WILCOX CO. Ashpit maintenance can be cut considerably by lining with B&W Kaocrete. Write for information on all B&W refractory castables.

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Read page 2 and circle number 145
BIGELOW-LIPTAK CORPORATION. When temperatures are high and expensive special alloy supporting castings must be used, Bi-met will save you money.

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Control refrigeration capacity
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JOHNSON SERVICE COMPANY. Single compact controller balances capacity with load, prevents short cycling, and equalizes wear of equipment. Mail coupon for full data.

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Pioneering water conditioning
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W. H. & L. D. BETZ. New techniques in water conditioning that reduce costs, save time, and aid production are being pioneered by Betz. Send for information.

Dependable demineralization pays
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INFILCO INC. When you specify Infilco demineralizers, you can rely on their performance. Write for information.

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free bulletins

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Air cleaning equipment

500-Dust collector manual

Dust collectors, including cyclone, wet or dry dynamic, and cloth screen arrester types are the subject of a 32-page bulletin. Uses of air conditioning, ventilating, conveying, drying, and cooling units are presented. KIRK & BLUM MFG. CO.

Air conditioning, heating, ventilating

502-Quieter hot air fans

Complete details and performance tables covering all circumstances in which many sizes and types of these high efficiency, low noise level industrial fans can be used are given in Bulletin C-102. Designed to fill any requirement for a Class I or Class II fan, this line of centrifugal fans is particularly suitable for handling hot air and gasses up to 600 F. Basic types are identified by backward or forward curving blades. CHICAGO BLOWER CORPORATION.

Boilers and boiler accessories

505-Boiler setting and baffle data

More than 30 boiler-setting plans are shown, with an analysis of how each arrangement of tubes is baffled to meet the specific boiler design problem in your plant. Bulletin BW-54. Twenty pages. THE ENGINEER CO.

SUBJECT INDEX

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506-Answers to hot water problems

Answers to your hot water problems are given in Booklet "Methods and Means." Operation and advantages of the instantaneous water heater as compared to the indirect method heater are thoroughly discussed and illustrated. PICK MANUFACTURING CO.

507-Water-tube boiler features

Water-tube package boilers, known as the Compak line, are described in seven-page Booklet 5000. Design and construction features are shown in cutaway drawings with a list of standard equipment, optional equipment, and performance curves. INTERNATIONAL BOILER WORKS CO.

508-Do your own boiler survey

Here's how to get a boiler survey form without obligation. Write for this bulletin covering the new CB self-contained boiler. Illustrations of installations, cutaway views of the boiler, and articles on how the units have proved themselves in specific applications are included. Four pages. CLEAVER-BROOKS CO.

509-Blowdown control chart

Determination of the rate of boiler blowdown and selection of a correctly sized heat exchanger are made possible with use of simplified Chart JPC, based on total dissolved solids in boiler water. Also given are recommendations for selection of blowdown equipment in accordance with normal operating conditions of boiler installation. HENSZEY CO.

510-Learn facts about boilers

Here's a factual down-to-earth discussion about all phases of specification, selection, and operation of steel fire-tube boilers. Bulletin 983 discusses flexibility, dependability, lower costs, and longer boiler life. Includes cost calculations showing how substantial savings can be made over a period of years. Gives a comprehensive discussion about maximum and nominal capacity. Twelve pages. KEWANEE BOILER DIVISION, AMERICAN STANDARD CORPORATION.

Building construction, materials

511-Mortar joints repaired simply

These seven simple steps for repairing worn or corroded mortar joints of brick or tile floors are presented in Bulletin E-37. Procedure involves use of non shrink, Embeco premixed mortar. THE MASTER BUILDERS CO.

512-Metal grating data

Uses of steel, aluminum, and stainless grating and stair treads are discussed in this bulletin. Lists safe load table with conversion factors. Gives data on standard widths and types of steel stair treads. Discusses bridge decking and suggested anchors for various grating installations. KLEMP METAL GRATING CORPORATION.

Compressed air supply

513-Family-album compressor catalog

A family album showing all the compressors and centrifugal pumps manufactured by the company is presented in Bulletin 603. Thumbnail sketches and brief descriptions of each type with sources of further information are included. Six pages. PENNSYLVANIA PUMP AND COMPRESSOR COMPANY.

Corrosion control

514-Coatings control corrosion

Catalog 3i describes coating properties and includes suggestions for selecting protective coating and surface preparation prior to coating. Amercoat coatings provide corrosion protection for structural steel, tanks, piping, and ductwork, and also contains properties and uses of Amercoat tank linings. Four pages. THE AMERCOAT CORPORATION.

515-Prevent boiler tube corrosion

Bulletin TR-537 discusses causes and methods of eliminating corrosion in boiler tubes. The data contained is the result of extensive studies by metallurgical experts. Eight pages. BABCOCK & WILCOX COMPANY.

516-Newest paints described

"Subox and Subalox Anti-Corrosive Paint—30th Anniversary," replaces the 25th anniversary issue you have in your files. It covers these paints as previously made and includes the newer varieties. Case histories show successful use of Subox paints on various types of industrial equipment. SUBOX, INC.

Electric distribution

518-Cable raceway for every job

Raceways for cable and conduit for all installation problems are discussed in this bulletin. Globetray can be cut to any length and quickly installed. Complete set of standard fittings is available to permit change of direction or eleva-

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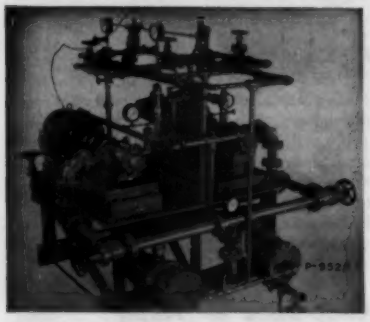

P-952-A—Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-ES2H size No. 25 unit.

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tion. Horizontal elbows, inside and outside vertical elbows, tees, crosses, covers, and special fastening devices save installation time and labor. Load data is given for typical installations. Eight pages. THE GLOBE COMPANY.

519-Current-limiting fuse charts

Hi-Cap fuses for the protection of loads above 600 amperes are described in six-page Bulletin HCS. Two handy charts are included: Current Limiting Effect and Opening Time Curves. Use of these fuses in conjunction with Fusetron fuses is explained. BUSSMANN MANUFACTURING CO.

520-Outdoor service equipment guide

Designed to make easier the selection of outdoor service equipment, 12-page Bulletin 2016 combines descriptive data on all available standard equipment—service entrance, receptacle type, dual control, three-phase units. HEINEMANN ELECTRIC CO.

521-Guide to planning bus duct

Latest concepts of bus enclosure for generator leads and switching stations are given in Bulletin 10004-A. Includes easy-to-understand guide of electric characteristics, ring size, working data, physical arrangement, and isometric installation layout. Gives recommendations for strength and simplicity for welded bus. Also includes typical examples for installation and maintenance economy. Eight pages. I-T-E CIRCUIT BREAKER COMPANY.

523-Correct that low power factor

Booklet 50B describes the Unit-Cell Box Type Capacitors which offer easy-to-install, economical means of correcting low power factor for large or small power consumers. Twenty-seven pages. SPRAGUE ELECTRIC CO.

524-New variable transformer ratings

Types 136 and 236 Powerstat Variable Transformers—design, new ratings, and performance—are discussed in eight-page Bulletin P354. THE SUPERIOR ELECTRIC CO.

525-Package plug-in busway

Construction and application of plug-in busway systems for feeding lighting and power loads in industrial plants is described in Bulletin GEA-6470. Shows how factory-assembled plug-in busway system permits direct connection to bus bars. Also lists ratings, weights, dimensions, installation data, and guide form specifications. Twenty pages. GENERAL ELECTRIC COMPANY.

528-Read about fuel oil additives

How to get complete protection from fuel tanks to burner tips is described in Bulletin 5012-A. Additives eliminate desludging operations, keeps screens and burners clean, improve atomization and combustion, eliminate smoke and soot, and reduce rusting, pitting, and leaks. Includes recommended amounts of additive per 1000 gallons of fuel oil. Four pages. DEARBORN CHEMICAL COMPANY.

Fuels and firing equipment

529-LP Gas—the Cinderella fuel

Three-color booklet gives history, characteristics, production, transportation, and use of LP gas. Describes 25 industrial uses, plus many uses in chemistry, transportation, and utilities. Booklet stresses high heating value and economical transportation. Discusses how LP gas supplies its own pressure-feed to equipment in use. Eight pages. GULF OIL CORPORATION.

530-New combustion sampling

Full story of a newly developed sampling system for continuous trouble-free sampling and oxygen measurement of combustion processes is told in Bulletin 703. Equipment described is designed for steam generating plants, rotary kilns and driers, open hearth furnaces, and tanks. ARNOLD O. BECKMAN CO., INC.

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531-Test with tong-type ammeters

How to obtain accurate ac and dc current measurements safely and without interrupting circuit is discussed in Bulletin TT-5515. Available in five types, tong-type ammeters measure both ac and dc up to 1000 amperes with fourteen scale ranges. Test ammeters can be used safely for measuring current on lines up to 2300 volts. Includes information on voltage attachment that permits simultaneous readings of both voltage and current. Ammeter is priced well within the range of portable test equipment for all power services engineers. Eight pages. COLUMBIA ELECTRIC MFG. CO.

Instruments and controls

534-Deflection indicator bulletin

Magnetic-amplifier deflection indicator for equipment in which early detection of relative movement is desirable is described in Bulletin 05B8385. Indicator safeguards hydrostations, compressor and pumping stations, drive shafts, and other applications. Visual or audible alarm systems for both remote and nearby locations can be obtained. Requires only

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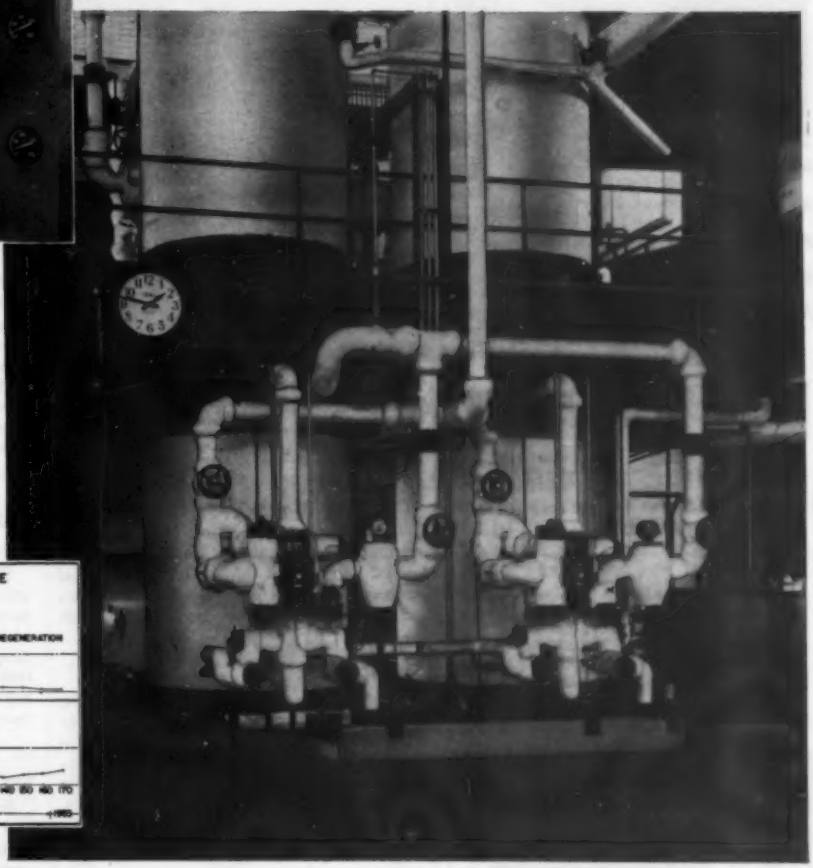
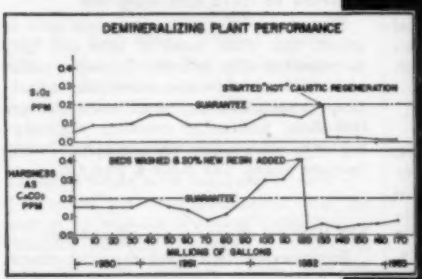


Waukegan Station Demineralization Plant

"CATEXER" "ANEXER" Demineralization Plant performance charts at Waukegan Station.



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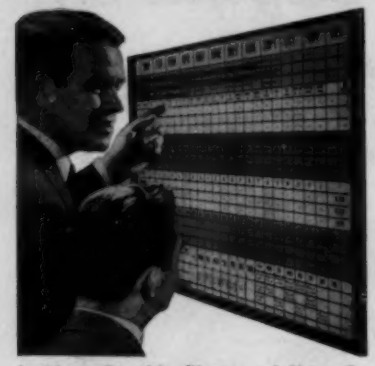

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60-cycle, 110-volt power source for operation. Eight pages. ALLIS-CHALMERS MANUFACTURING COMPANY.

535-Pocket-size thermocouple manual

Bulletin F 7255 is a convenient pocket-size reference manual for instrument men and engineers. Gives thermocouple temperature-millivolt equivalents. Temperatures are expressed on the International Temperature Scale of 1948, and electromotive force is expressed in absolute units. WHEELCO INSTRUMENTS DIVISION, BARBER-COLMAN COMPANY.

536-All-purpose water flow meters

Principles of operation of nutating-piston-type meters are explained in Bulletin 36. It contains illustrations and data of typical installations, trap strainers, air release valves, high-pressure meters, and meter registers for the measurement of most fluids. Twenty pages. BUFFALO METER CO.

537-Positive mercury switch controls

Positive controls for pressure, vacuum, temperature, liquid level, and other variables, equipped exclusively with sealed mercury switches are described in Bulletin 26/Me. Four pages. THE MERCOID CORP.

538-Hot-water boiler safety controls

Safety valves, low-water fuel cutoffs, and feeder cutoff combinations are described with engineering data in Bulletin P-30. Common questions about hot-water boiler safety are answered with the aid of colored diagrams. Eight pages. MCDONNELL & MILLER, INC.

Lubrication

539-Portable oil maintenance units

New portable line of oil filters makes possible on-the-spot maintenance of lubricating and industrial oils. Bulletin 316 also includes information, illustrations, and references about combination oil filters and reclaimer units. These units are ideal for filtration and vacuum vaporization of water and other volatile contaminants in turbine, diesel, transformer, transmission and hydraulic oils. Four pages. THE HILLIARD CORPORATION.

Maintenance items

540-Hydraulic system chart

"Trouble-shooting Chart for Hydraulic Systems" is designed for display in shops. This chart will help operators and maintenance men spot and cure common troubles. Discusses such troubles as noisy pumps, leakage, overheating, and erratic action. Includes time-proven recommendations to cure most common troubles. SUN OIL COMPANY.

541-New electrodes for boiler repair

New line of low-alloy steel arc welding electrodes for boiler repairs and high pressure piping fabrication is contained in Bulletin 55CM. Electrodes eliminate weld cracking and reduce stress-relieving to a minimum. Preheat temperatures can be decreased to reasonable levels. THE CHAMPION RIVET COMPANY.

542-Hardness data card

Hardness conversion chart shows the approximate relation between hardness values obtained by various testing systems and the tensile strength of carbon and alloy steels. Hardness systems covered in Bulletin TDC-183 are Brinell, Monotron, Vickers, and Rockwell. THE BABCOCK & WILCOX COMPANY.

Materials handling (bulk)

545-How to store bulk materials

Storage bins for bulk materials such as ashes, coal, coke, sand or lime are fully discussed in this bulletin. Contains tables of densities of flowable materials, capacities, description of wall construction, test data, and other relevant engineering data with many photographs. Twenty-nine pages. THE NEFF & FRY CO.

547-How to choose a speed reducer

Engineering data, load capacity charts, and installation dimensions are included in Bulletin 125 for the complete line of vertical worm-gear speed reduction units. Units are available in capacities from 50 to 500 hp. Special designs are available for larger units as well as for double-reduction needs. Eight pages. THE CLEVELAND WORM AND GEAR COMPANY.

Mechanical power transmission

549-Gearmotor selection manual

How to select the right Gearmotor or Motogear is explained in detail in Bulletin 2447. Gives solution to two typical installation problems. Includes 12 pages of selection charts and dimensions for complete line of Gearmotors and Motogears for Class I, II, and III installations. Describes Gearmotors with capacities from 1 to 30 hp and Motogears with capacities from 1 to 60 hp. Recommended bulletin for the library of all power services' engineers. Twenty-eight pages. LINK-BELT COMPANY.

Piping, tubing, and hose

550-How to use expansion joints

This expansion joint design guide, which is filled with engineering application and selection data necessary to proper solution of pipeline expansion problems, shows schematic piping layout. Catalog 153 discusses various types of expansion joints on the market and includes a simplified selection chart. A welcome addition to any piping engineer's library. Twenty-four pages. FLEXONICS CORPORATION.

551-Friction loss chart

Friction loss chart for flexible hose is offered in Bulletin 41-44 along with application and technical data. Accessories, installation data, and price lists are included. Eighteen pages. THE FLEXAUST COMPANY.

552-Bladeless pump moves waste

How you can pump sewage and trash with bladeless pump is described in Bulletin 5400K-1. Includes selection tables that give capacity and total head for each pump size. Discusses performance comparison between bladeless and conventional trash pumps. Also includes installation dimensions for pump sizes from 2 to 5 inch for both vertical and horizontal mounting. An excellent manual for all power services engineers. Sixteen pages. FAIRBANKS-MORSE.

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553-Stop leaks with mechanical seal

External rotating mechanical seal for pumps or agitator shafts is explained in Bulletin MS-954. Discusses field-proven experience in handling acids, alcohols, alkalies, hydrocarbons, and tarry materials. Seal gives low friction load on shafts—insures lower starting torque and power costs. Available in standard sizes from ⅞ to 2⅛ inches. Includes recommendations for use under various pressure and temperature conditions. Eight pages. UNITED STATES GASKET COMPANY.

Pumping equipment

554-Opposed impeller pump balance

How opposed impellers balance axial thrust is covered in 12-page Brochure 1502. Sizes from 2 to 4 in., with 2 to 8 stages, are presented for capacities to 1000 gpm, pressures to 1200 psig, and temperatures as high as 350 F. DELAVAL STEAM TURBINE CO.

555-Pump large volumes quietly

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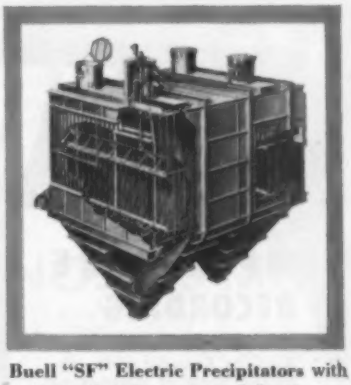

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are discussed in Bulletin HC-855. Contains performance capacity charts for 12 different pumps. Also included are dimensional reference drawings for installation and foundation purposes. Four pages. BELL & GOSSETT COMPANY.

556-Sewage and sump pump selection

Comprehensive, eight-page Bulletin 325-A32 is for engineers, architects, and contractors who specify sewage and sump pumps. It describes in detail three types of pumps: The NKS Vertical Wet Pit Single or Duplex; the NKV Vertical Dry Pit; and the NKH Horizontal. AMERICAN-MARSH PUMPS, INC.

557-How to use package feeders

Proportioning pumps and package chemical feeding units are described in this four-page folder. With liquid ends available for about 85 percent of all chemical pumping requirements, the pump is designed for use where a controlled capacity of fluid is necessary. How feeding unit can be connected to piping of your plant and to electrical control equipment is explained. BIRD-ARCHER CO.

558-How to figure pump heads

How to determine total head against which pump must operate is only one of the valuable sections in 12-page Bulletin 353-1000 on the Bilton pump, a general purpose pump suitable for medium and low head service. BYRON JACKSON DIVISION, BORG-WARNER CORPORATION.

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559-Automatic sump pump data

Complete engineering data on a line of sump pumps that covers every application is presented in Bulletin 5530. Submersible sump pumps, vertical pumps, and hydraulic operated drainers are discussed. Four pages. PENBERTHY INJECTOR COMPANY.

Refractories and insulation

560-Refractory construction

The different types of construction considered standard for industrial refractory are described in Bulletin 39. Profusely illustrated. Twenty pages. BIGELOW-LIPTAK CORP.

Traps, strainers, and separators

561-Straight wash pressure filters

Advantages of this type of filter are discussed with the aid of photographs and diagrams in Bulletin 720. Also included is a table of sizes, capacities, weights and connection sizes. Four pages. AMERICAN WATER SOFTENER COMPANY.

562-Get "bone dry" compressed air

Bulletin describes how ball-float trap eliminates all water and oil from compressed air system. Equipment is entirely mechanical and automatic. Requires no maintenance—has minimum working moving parts. Contains information on line of after-cooler-separator-filters. JAS. A. MURPHY & COMPANY., INC.

564-Answers about clarifiers

Clarifier and thickener requirements for a wide range of capacities and solids removal loads are listed in Bulletin W-800B-S-6000B. Presented in question-and-answer form, bulletin explains need for and function of circular sedimentation basins, sludge scrapers, and central inlet wells. Sixteen pages. INFILCO INC.

Turbines

566-Speed control fundamentals

"Fundamentals of Turbine Speed Control," 32-page Brochure H-21, is an educational piece intended to clarify the operation of common types of automatic speed control for steam turbines. Simplified diagrams illustrate operating principles of actual control systems. ELLIOTT CO.

Valves and regulators

567-Pressure valves for all ranges

Catalog 10 describes List 960 and 990 valves. The 960 is for a pressure range of 200 lb at 100 F to 380 lb at 1000 F. The 990 is for higher pressures. CHAPMAN VALVE MANUFACTURING CO.

568-Accurate valve sizing manual

Comprehensive and easy-to-understand discussion of the importance of proper valve sizing is contained in Bulletin 120-2-55. Also contains formulae and nomographs for sizing valves to meet any conditions of steam, liquid, and gas flow. Additional tables of flow coefficients for the many configurations of diaphragm-

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control inner valves are also given. Twenty-four pages. BLACK, SIVALLS & BRYSON, INC.

569-Control valve reference book

Three basic types of single-seated diaphragm control valves are discussed in 15-page Bulletin 5304. Cutaway views and charts with complete specification data make this a good reference book. LESLIE CO.

570-Bronze solder-end valves

Solder-end globe, gate, and check valves are described in this circular. Valves are suited for offices, warehouses, and industrial buildings. Includes recommendations for use in steam, hot and cold water lines, heating and air-conditioning systems, oil, natural gas, and underground water lines. Seats permit repacking under pressure. THE LUNKENHEIMER COMPANY.

571-Read about control valves

Discussion of equipment for the control and regulation of steam, water, air, oil, and gas is contained in composite Bulletin C-50. This bulletin also contains descriptions of proper application for all pressure, flow, and liquid level controls. Four pages. MCALEAR MANUFACTURING COMPANY.

Water supply and treatment

572-Demineralizing handbook

"Handbook on Demineralizing," Bulletin 5800-B, compares various methods of water treatment including demineralizers and evaporators. It goes into characteristics of various types of available cation and anion exchange materials and operating costs. Forty pages. COCHRANE CORP.

573-Water treatment explained

"Water Conditioning—One Source for Every Need," 19-page Bulletin 611B, presents the wide range of products available from this company and explains how each type solves particular problems. ELGIN REFINITE DIV., ELGIN SOFTENER CORP.

577-Acid on cooling towers

Discussion of how chemical and bacteriological attack can be controlled by acid treatment and wood preservatives to kill fungi appears in Technical Paper No. 130. A good reference work for anyone interested in cooling towers. Eight pages. W. H. & L. D. BETZ.

578-All phases of purification

"Boiler Feedwater Treatment," 19-page Bulletin BFT-1, covers Inversand zeolite softeners, color process chemical softeners, and demineralizing units, including silica removal by ion exchange. HUNGERFORD & TERRY, INC.

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spot news

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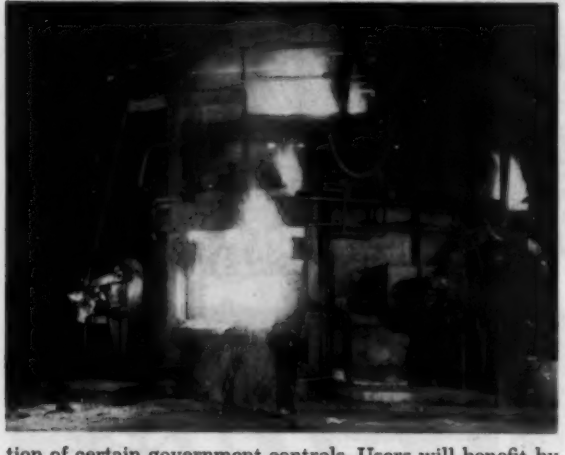
● Stainless steel production hits the jackpot

Production of stainless and heat-resisting steels in 1955 hit an all-time high, according to preliminary figures released by American Iron and Steel Institute. Production for the year was 1,191,177 net ingot tons, compared to 852,021 net tons for 1954. This 40-percent increase is even greater than the overall steel increase of approximately 36 percent, which in turn leads other significant metal production advances.

Other advances include changes in stainless steel designations resulting from improved practices and elimination of certain government controls. Users will benefit by even greater uniformity and dependability from these steels. Producers have been able to work to closer alloy limits, particularly on carbon. As a result, maximum permissible carbon content has been lowered for six grades: 301, 302, 302B, 316, 317, and 446. Low carbon content is required in most types for maximum resistance to corrosion, while higher carbon content is used for increased hardness, as in cutlery grades.



● What is the best land-to-building ratio?

How much space does a factory need? A Minneapolis realtor stated at a recent meeting of the National Institute of Real Estate Brokers that "Industries desiring to expand or relocate require sites that offer a ratio of 4 or 5 sq ft of vacant land to 1 sq ft of land to be covered by buildings." He reports that Westinghouse Electric Corporation favors a 10:1 ratio for its particular type of operation. To put this ratio in terms of acreage, an 80,000-sq ft building would require a 20-acre site.

● Line-up changes in the news

Infilco Inc. has announced the formation of an Australian subsidiary with offices in Sydney. A fourth subsidiary is in process of formation in Japan. . . . Morse Chain Co., a Borg-Warner subsidiary, has acquired Eberhart-Denver Co. of Denver, manufacturers of speed reducers, and its affiliate the Spreco Co. of Chicago. . . . Rockwell Manufacturing Co. has acquired the assets of Locomotive Finished Materials Company of Atchison, Kansas. LFM casts, machines, and assembles equipment for the petroleum, mining, power, and other industries. . . . Soreng Products Corporation and A-P Controls Corporation have merged to form the newly created Controls Corporation of America. . . . Cochrane Water Conditioning, Limited has assumed engineering, manufacturing, and sales activities in Canada as a subsidiary of Cochrane Corporation, succeeding Canadian General Electric Company, Limited. . . . The Plomb Tool Company has acquired certain assets of the Tubing Appliance Company, Inc., including essential machinery, tooling, patents, and inventories of TAC ratchet wrenches. . . . Bohn Aluminum & Brass Corporation has acquired the assets of the Betz Corporation of Hammond, Indiana, manufacturers of heat transfer equipment for commercial refrigeration and air conditioning.

● Big orders in the news

Riley Stoker Corporation has been awarded a contract to build a new boiler for the A. E. Staley Manufacturing Co., processors of corn and soybeans. Boiler will replace two older boilers, and will have a capacity of approximately 125,000 lb/hr. Cost of complete project is estimated at about $1 million. . . . New water treating equipment to double the boiler-feed capacity at Consolidated Edison Company's Astoria, L. I. station has been ordered from Belco Industrial Equipment Division of Bogue Electric Manufacturing Co. Installation will add another 100,000 lb/hr capacity to existing units, bringing the total to 200,000 lb/hr. Belco will furnish one new sodium unit and one new hydrogen unit identical to existing units. Original degasifier had been previously designed to handle the 200,000 lb/hr.

● Expansions in the news

Orangeburg Manufacturing Co., Inc. has started work on a plastic pipe plant adjoining its Orangeburg, N. Y. plant, to augment its present lines of electrical fiber conduit and bituminized-fiber sewer pipe. . . . The Okonite Company has purchased 160-acre Studebaker-Packard plant at New Brunswick, N. J. to expand its facilities for producing its major line of power, communication, and control cables. . . . Johns-Manville will build a new plant to manufacture Transite asbestos-cement pipe products near Stockton, Calif. . . . L. O. F. Glass Fibers Company has leased a 15,000-sq ft building and a 15,000-sq ft lot in Burbank, Calif. for production of glass fiber blankets. . . . Hills-McCanna Company is going to build a 100,000-sq ft plant for increased production of diaphragm valves and chemical metering and proportioning pumps on a 20-acre site in Carpentersville, Illinois. . . . Owatonna Tool Co. is building a new plant outside Owatonna, Minn. to house expanded facilities for manufacture of hydraulic equipment such as rams and pumps. . . . Cutler-Hammer, Inc., pioneer electrical manufacturers, will soon move into a

new plant in Los Angeles, to give more complete service in that area. . . . Resistoflex Corporation has moved into a new plant and research facility at Roseland, N. J. that doubles its former capacity for manufacture of special purpose hoses, hose assemblies, and plastics. . . . James B. Clow & Sons, Inc., producers of cast iron pressure pipe, has just announced a $5 million expansion program which includes a new cast iron pipe plant to be built in Bensenville, Ill. . . . The Lunkenheimer Co. has sold its Carthage plant, formerly devoted to the manufacture of iron and steel valves. These operations are being transferred to a new plant adjacent to the company's Fairmount, Cincinnati plant.

● Coal stocks in the cellar

This year began with coal users owning 47 day's supply of bituminous coal. This is nearly 22 percent under the 60 day's supply — regarded as the prudent minimum— which was above ground at the beginning of 1955. Under these circumstances, one of the important "new" markets needing coal during this year is coal inventory!

● New paint base makes super paints

New paste-pigment that makes use of liquid chlorinated polyphenyl has several distinctive advantages over previous paints, varnishes, and sealer bases such as oil (linseed oil-turpentine base) and latex (rubber base). Sealing and surfacing paints and varnishes, manufactured with patented CPC are nonoxidizing, noncorrosive, noninflammable, and can be made odorless. They are also nonhygroscopic. Applied finish is absolutely waterproof —it forms a solid barrier that blocks moisture 100 percent for an indefinite period, even when exposed constantly to acid and alkaline atmospheric conditions. CPC makes possible manufacture of copper, bronze, and many other metallic paints that retain all the luster, brilliance, and beauty of the base metal elements. Other metallic paints that can be manufactured successfully with CPC base include aluminum, silver, gold, chromium, lead, antimony, nickel, titanium, iron-beryllium, zinc, tin, stainless steel, vanadium, and tungsten. New paint base has a toxic effect upon bacteria. When applied to boat hulls, it stops the formation of barnacles for several years.

● Synthetic-fiber papers progress to practicality

Pilot plant experience has shown that manufacture of synthetic-fiber paper from Nylon, Dacron, and Orlon, and from blends of these fibers with wood pulp is commercially practical. Uses that offer the most promise include: paper-like structures for electrical insulation, high-pressure laminate reinforcement, map and chart paper, tracing paper and cloth, fabric-like structures for filtration, tarpaulins, coated fabrics, electrical tapes, and filter felts. Adding 25 percent Nylon to a pulp bonded with Nylon resin binder improves tear strength of the paper 3½ times and fold endurance 42 times. Tear strength of 100-percent Nylon paper averages 14 times greater than cellulosic paper bonded with the same resin. Fold endurance is more than 75 times greater. Many of these papers bear little resemblance to "paper" in the usual concept. Term is applied because they are made on paper-

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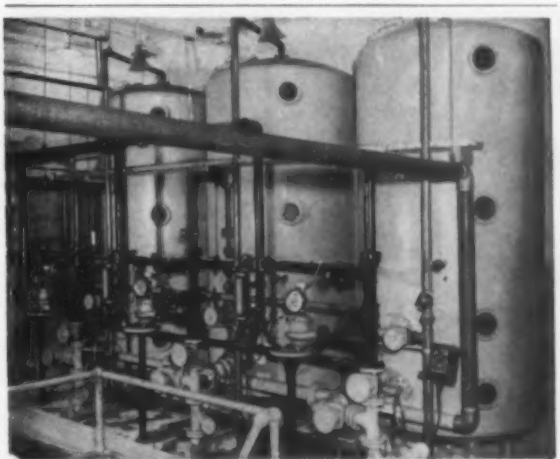

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spot news

. . . starts on page 80

making machinery—non-woven bonded structures would be a more proper term. They can be made with a wide range of appearances and characteristics, from crisp paper-like to bulky felt-like structures.

● Lucky strike for J-M?

"Lucky Gypsum" deposit, located between Las Vegas and Henderson, Nev., is being investigated by Johns-Manville Corporation — which is considering entering the gypsum business. Their Exploration Department is also examining gypsum deposits in other parts of the country. Diamond drilling, trenching, and other exploratory work on the property will soon begin, and should be completed within a year. Should the company enter the business, gypsum products would substantially augment the present line of J-M building materials.

● An Oscar for Babcock & Wilcox

Marine industry's top advertising honor, the "Atlas" Award, has been awarded to the Boiler Division of The Babcock & Wilcox Company for 1955. Awards are designed to stimulate institutional advertising in support of a strong American merchant marine. Chief trophy is an illuminated globe supported by a bronze figure of Atlas, symbolic of how shipping supports the world's economy. Award to B & W is based upon a series of seven advertisements which that company devoted to the merchant marine during the past year. Sun Oil Company received an honorable mention award.

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● Emphasis on fire

Fourteen different fire training courses, each lasting three days, will be conducted during 1956 on the 10-acre fire test field of Ansul Chemical Company, at Marinette, Wis. Registration — which is on a first-come, first-served basis—will be limited to 25 men for each class to insure maximum benefit to those participating. There is no tuition fee. Students will be taught to use hand, wheeled, and large stationary fire equipment against flammable liquid and propane gas fires of all sizes and types. They will return to their home plants better equipped to train fire brigade members and others in the latest fire-fighting techniques. Schedule also calls for group discussions, motion picture film showings, and a plant tour.

● Emphasis on falls

The National Safety Council will soon begin an intensive nationwide campaign to reduce accidental falls. Falls have been singled out for special emphasis because of their great importance in the total accident picture. Falls account for more accidental deaths and injuries than any other cause, except traffic accidents. Falls take a heavy toll of workers, ranking just below handling objects as the greatest source of disabling occupational injuries. Falls are costly accidents — compensation payments are substantially above those for other accidents. Falls account for more than half the injuries to office workers. Campaign will present safety personnel with an assortment of training aids designed to arouse workers' enthusiasm for protecting themselves.

● Engineering institutes planned by University of Wisconsin

Engineering institutes planned by University of Wisconsin Extension Division and College of Engineering include: Industrial Wastes on March 12 and 13; Engineering Economics on April 11 and 12; Industrial Instrumentation on April 19 and 20; Industrial Power Systems on May 1, 2 and 3; and Corrosion Control on May 17 and 18. Advance registration is requested whenever possible. Detailed announcements will be sent to interested persons two to three weeks in advance of institute dates. Further information can be obtained from Engineering Institutes, University Extension Division, University of Wisconsin, Madison 6, Wisconsin.

● Thermoplastic armored cable gets UL's blessing

For the first time, armored cables with thermoplastic-insulated conductors have been approved by Underwriters' Laboratories. Cables from three manufacturers have been tested and found acceptable. Each cable had conductors insulated with electrical grade Opalon vinyl chloride, a thermoplastic compound that complies with the Type T requirements of the National Electrical Code. Opalon is a product of Monsanto Chemical Company. In-

dividual conductors in the new cables are wrapped with 30-pound, wax-impregnated Kraft paper, applied with 50-percent overlap. Each cable contains an aluminum bonding strip. Cables were developed by Columbia Cable & Electric Corporation, Clifton Conduit, Inc., and Ettco Wire & Cable Corporation.

● Automation — more or less?

Automation is one of the best solutions to competition problems, according to Arthur F. Vinson, General Electric Company vice president of manufacturing. Automation, or continuous automatic production, is by no means restricted to larger businesses, he said. Small businesses, alert to the opportunities of automation, will improve their competitive positions and grow. As for the larger businesses, they must certainly evolve with the times, for no business is big enough to be permanently secure, he said. . . .

On the other hand, automation concept of distribution could prove a dangerous delusion if it is oversold to business men, warns Judson S. Sayre, president of Norge Division, Borg-Warner Corporation. He said "You might automate machines but you cannot automate people—or automate the sales of an appliance the way you can do a can of beans." Sayre declared, "Automation in industry has brought better products with a greater dollar value. However, the exaggerated implications of the 'automation' ogre, if publicized widely in the consumer press, might produce a dangerous psychological effect which could frighten the daylights out of people generally — even to the point of creating a serious sales slump — should there be even a mild recession from our present high economy."

● Power plant paradox in L. A.

Steam power plant problem currently before the courts is a paradox. On one hand, growing need for electric power by industry and residents of the Los Angeles Basin requires construction of additional steam power plants. On the other hand, power plants burn huge quantities of high sulfur-content fuel oils during winter months, spewing tons of sulfur dioxide into the air daily. Emissions are believed capable of producing crop damage, eye irritation, and property damage in vicinity of the power plants. In addition, tons of particulate matter, organic acids, hydrocarbons, and other pollutants are emitted daily. If unchecked, this could result in the present 502 tons of total contaminants from fuel plants rising to over 1300 tons by 1970. Seven new power plants are now planned in this district.

● Those ubiquitous transistors

First application of transistors in protective relays for electric power systems has been announced by General Electric Company. Newly developed alarm relay controlled by transistors is 3½ times more sensitive than previous designs. In alarm unit of the negative-phase-sequence overcurrent relay where transistors are now applied, the relay becomes more sensitive in protecting generators. When relay was first introduced in 1953 with an alarm unit of conventional design, the alarm would function if the negative-phase-sequence current exceeded 25 percent of full-load positive-phase-sequence current. With transistors, the alarm unit can now detect 7 to 15 percent of this quantity.

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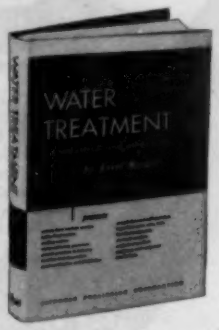

1951, 525 pages, $12.00

This book provides an exhaustive, practical and up-to-date reference work on the conditioning and treatment of water supplies for industrial and domestic uses. 18 fact-packed chapters cover impurities and methods of minimizing or eliminating them; water requirements; water-treatment practices in various industries; boiler feed waters and cooling waters; water softening processes; sampling precautions; and many other important topics.

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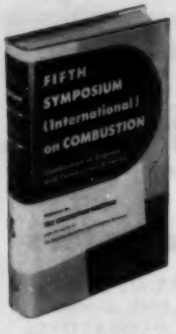

FIFTH SYMPOSIUM (International) on COMBUSTION

Combustion in Engines and Combustion Kinetics

by The Standing Committee on Combustion Symposia,

THE COMBUSTION INSTITUTE

1955, 848 pages, $15.00

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Standards of the Hydraulic Institute—10th Edition, by The Hydraulic Institute; 234 pages; $4.75, domestic, $5.75, foreign.

This book is prepared with primary emphasis on its use as a textbook. Modern typography, illustrations, loose-leaf binding, and off-set index tabs make this book easy to read and well suited for quick reference.

Three sections are devoted to information on all phases of modern pump design. A data section is also included giving friction loss for water and viscous liquids, and for valves and fittings. Numerous solved mathematical problems are contained that give calculations for net positive suction head, pump size for specific conditions of head and volume, determination of critical sigma, and pump performance when handling viscous liquids.

Contains a wealth of information on installation, operation, and maintenance of pumps and piping—this in addition to its thorough coverage of design as such.

Thermal Power from Nuclear Reactors, by A. Stanley Thompson and Oliver E. E. Rodgers; John Wiley & Sons, Inc.; 229 pages; $7.25.

An excellent, highly technical treatment that analyzes engineering problems involved in the development of nuclear reactors for generating mechanical or electric power. Consisting of eight chapters, it carries the reader from a general introduction into the overall concept of the function of a nuclear reactor, to the calculations involved in determining many components of a nuclear reactor system.

Recommended reading for all engineers with a knowledge of calculus who desire to become more familiar with the theory involved in nuclear processes. Typography and illustrations are typical textbook-type and result in easy reading.

Not recommended for anyone who is interested in merely a superficial discussion of nuclear processes. This book will demand some spadework in calculus for most readers if they wish to get the maximum benefit from the formulas included in this text.

An Annotated Bibliography on Noise, Its Measurement, Effects and Control, by Industrial Hygiene Foundation of America, Inc., Mellon Institute; 364 pages; $7.50.

A chronological list of 2336 references useful to engineers, executives, and others concerned with problems resulting from excessive noise. Typography is suitable for the reference-type book, but not recommended for continuous, lengthy reading.

No attempt is made at critical evaluation of the material listed. This bibliography will fill the need for information on the subjects concerned in light of current importance of this subject. Material is indexed by both subject and author and the references are arranged for greater ease in locating a particular subject.

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- *Contaminants in the Air*
- *Demineralization—A Means to Purer Water*
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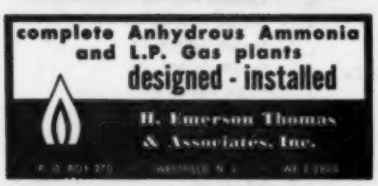

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coming events

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Apr. 1-5	ASME Oil, Gas, and Power Conference	Jung Hotel New Orleans
Apr. 2-4	AIEE Southwest District Meeting	Dallas
Apr. 5-7	Eighth Biennial Electric Industry Show	Shrine Hall Los Angeles
Apr. 16-17	ASME Gas Turbine Power Division Conference	Hotel Statler Washington, D. C.
Apr. 16-18	AIEE Great Lakes District Meeting	Fort Wayne Indiana
May 2-4	AIEE Northeast District Meeting	Rochester, N.Y.
May 17-19	NY State Society of Professional Engineers 30th Engineering Ind. Exp.	Statler Hotel New York City
June 17-21	ASME Semiannual Meeting	Statler Hotel Cleveland
June 25-29	AIEE Summer and Pacific General Meeting	San Francisco
Sept. 10-12	ASME Fall Meeting	Denver
Sept. 17-21	ISA 1956 Conference and Exhibit	Coliseum New York City
Oct. 1-5	AIEE Fall General Meeting	Morrison Hotel Chicago
Oct. 8-10	ASME Lubrication Conference	Atlantic City New Jersey

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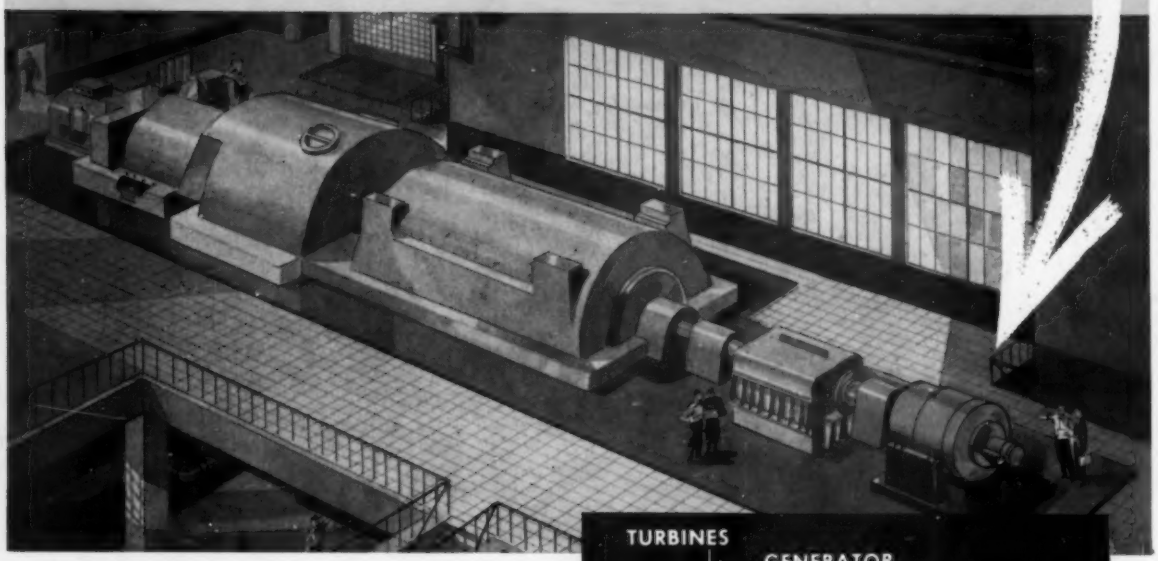
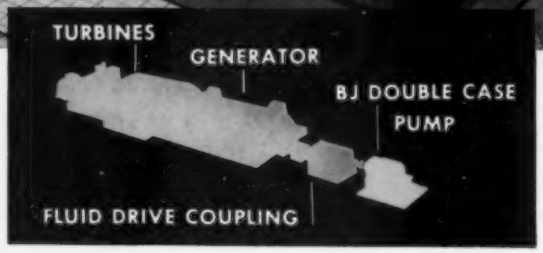
Byron Jackson makes history with World's Largest Boiler Feed Pump!





Byron Jackson is building the world's largest double case, high pressure boiler feed pump. According to BJ engineers, this pump will be at least twice as large as any boiler feed pump now in existence in the world. This huge unit—rated at 12,000 hp—will deliver 6,330 gallons per minute of feed water against a total dynamic head of 6,400 feet, or approximately 2,700 pounds per square inch at an operating speed of 3,510 rpm. It is being built for the Consolidated Edison Co. of New York, Inc.

A modification of the Byron Jackson-originated double case barrel type feed pump, the unit will consist of a cylindrical outer barrel and cover enclosing a horizontally-split inner volute case. The double volute design, together with back-to-back mounting of the impellers, provides for quick, uniform heating and reduces axial and radial thrust to a minimum.

UNIQUE DRIVE SYSTEM

For this BJ super pump, power company engineers are employing an altogether new concept of drive, the main generator steam turbine. Power is transmitted through an American Blower Corporation fluid drive coupling for variable speed operation to meet all load conditions.

To provide trouble-free operation, BJ engineers will incorporate packless type stuffingboxes with controlled leakage as well as a rotating element of rigid construction, limiting shaft sag to about one-third of the wear-surface clearances. Amazing as it may sound, this pump could be run dry.

ANOTHER BYRON JACKSON "FIRST"

This pump represents one more pioneering step undertaken by Byron Jackson in its long history of designing rugged, trouble-free pumps for any service.

BJ

Byron Jackson

Division of Borg-Warner Corporation
P. O. Box 2017A, Terminal Annex
Los Angeles 54, California

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